COUNTWAY LIBRARY
HC 16WG 8.

14.A.81.

BOSTON MEDICAL LIBRARY

PURCHASED FROM THE INCOME OF THE

OLIVER F. WADSWORTH FUND

DISEASES

OF THE

GENITO-URINARY ORGANS

AND

THE KIDNEY

BY

ROBERT HOLMES GREENE, A.M., M.D.

PROFESSOR OF GENITO-URINARY SURGERY, MEDICAL DEPARTMENT OF FORDHAM UNIVERSITY; GENITO-URINARY SURGEON TO THE CITY AND TO THE FRENCH HOSPITAL, NEW YORK CITY; FELLOW OF THE AMERICAN ASSOCIATION OF GENITO-URINARY SURGEONS

AND

HARLOW BROOKS, M.D.

PROFESSOR OF CLINICAL MEDICINE, UNIVERSITY AND BELLEVUE HOSPITAL MEDICAL SCHOOL; VISITING PHYSICIAN TO THE CITY HOSPITAL AND TO THE MONTEFIORE HOME FOR CHRONIC INVALIDS, NEW YORK CITY; CONSULTING PATHOLOGIST TO THE MUHLENBERG HOSPITAL, PLAINFIELD, AND TO THE HACKENSACK HOSPITAL, N. J.; CONSULTING PHYSICIAN TO THE BETH ISRAEL AND TO THE UNION HOSPITALS, NEW YORK; TO THE ST. MARY'S HOSPITAL, HOBOKEN; TO THE GREENWICH HOSPITAL, AND TO THE NEW LONDON MEMORIAL HOSPITAL, CONN.

FOURTH EDITION, THOROUGHLY REVISED

PHILADELPHIA AND LONDON

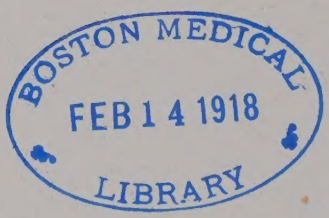
W. B. SAUNDERS COMPANY

1917

14998 Had 4 95

Copyright, 1907, by W. B. Saunders Company. Revised, reprinted, and recopyrighted September, 1908. Revised, reprinted, and recopyrighted January, 1912. Revised, reprinted, and recopyrighted April, 1917

Copyright, 1917, by W. B. Saunders Company



PRINTED IN AMERICA

PRESS OF
W. B. SAUNDERS COMPANY
PHILADELPHIA

THIS BOOK IS DEDICATED

TO

Lemuel Bolton Bangs, M. D.

AS A TRIBUTE OF RESPECT FOR HIS RESEARCHES IN GENITO-URINARY SURGERY AND FOR THE HIGH STANDARD HE HAS ALWAYS MAINTAINED AS A MEMBER OF THE MEDICAL PROFESSION

PREFACE TO THE FOURTH EDITION

THE demand for a fourth edition has caused the authors to feel deeply their sense of responsibility to their readers. The fact that more knowledge is being accumulated as to the nature and treatment of malignant growths in the urinary tract and to other diseased conditions of the kidney, but is not as yet fully crystallized, has made the task a difficult one in choosing the new material for this work. We have endeavored as much as possible, without overburdening the text, to give the result of our own experience and to avoid as far as possible speculative views, thus endeavoring to make the book of practical utility and to base our theory and practice on a sound pathologic and physiologic basis.

ROBERT HOLMES GREENE.
HARLOW BROOKS.

78 EAST 56th STREET,
NEW YORK CITY, *April*, 1917.

PREFACE

It has been the purpose of the writers to present in this volume a discussion of the more important disease conditions of the uro-genital tract, taken from the standpoint of the general practitioner and surgeon. In so far as possible they have attempted to incorporate such methods as they personally have found most practical and useful, all of which they believe may be successfully employed in the hands of any well equipped practitioner, familiar with modern medical and surgical technic.

The writers do not profess that the book is complete; this would be impossible in a work of this size. They have attempted to devote the greatest amount of space and the fullest descriptions to those conditions and methods which have appeared to them to be of the greatest importance, or to those which, being of recent development, may be presumed to be less familiar to the practitioner.

A larger amount of space has been devoted to the urinary organs proper, and relatively less has been said of purely sexual disorders.

The work is the conjoint product of a surgeon and a physician, and it is intended that equal attention should be devoted to both medical and surgical aspects of these diseases.

References to literature have not been exhaustively made. So many suggestions of value have, however, been found in the work of Berger and Hartmann and in that of Frisch and Zuckerkandl that they require especial mention in this preface.

Robert Holmes Greene.
Harlow Brooks.

CONTENTS

CHAPTER I

PAGE

General Examination of Patients ... 17
The Instrumental Examination ... 32
Catheterization ... 43
The Value of the X-ray in Diagnosis ... 51

CHAPTER II

Endoscopy.—Cystoscopy.—Catheterization of the Ureters ... 56
Endoscopy ... 56
Cystoscopy ... 60
Instrumental Examination of the Kidney ... 70
Catheterization of the Ureters ... 70
Methods of Separating the Urine from Each Kidney without Catheterizing the Ureters ... 79
Tests Showing the Permeability of the Kidney ... 80
Test Showing Permeability of the Kidney Associated with Ureter Catheterization ... 86

CHAPTER III

The Care of Urethral Instruments.—Preparation of Patient for Operation and After-care ... 90
The Care of Urethral Instruments ... 90
Preparation of Patient for Operation ... 96

CHAPTER IV

Examination of the Urine and Urethral Exudate ... 112
Examination of the Urine ... 112
Urinary Constituents ... 114
Microscopic Examination of the Urine ... 119
Organized Deposits ... 120
Crystalline Deposits ... 125
Bacteria ... 127
Examination of the Urethral Exudate ... 128
Examination of the Seminal Secretion ... 139
Examination of Secretions and Exudates from the Female Genitals ... 142
Examination for the Spirochæta Pallida ... 144

CHAPTER V

The Kidney ... 147
Embryology ... 147
Anatomy ... 148
Physiology ... 154
Compensation in Renal Disease ... 158

CHAPTER VI

The Blood in Diseases of the Kidney ... 163
Blood-pressure in Renal Disease ... 170

CHAPTER VII

PAGE

The Ocular Manifestations of Renal Diseases ... 175

CHAPTER VIII

The Kidney in Acute Infectious Diseases.—Suppurative Nephritis 179
The Kidney in Acute Infectious Diseases ... 179
Suppurative Nephritis ... 184

CHAPTER IX

Bright's Disease ... 194
Pathology ... 194
Symptoms, Diagnosis, Course, and Prognosis ... 206
Treatment ... 212

CHAPTER X

Uremia ... 223

CHAPTER XI

Tuberculosis of the Kidney.—The Kidney in Syphilis ... 237
Tuberculosis of the Kidney ... 237
The Kidney in Syphilis ... 244

CHAPTER XII

Malformations and Displacements of the Kidney ... 247
Congenital Malformations ... 247
Movable and Floating Kidney ... 250
Hydronephrosis ... 253

CHAPTER XIII

Wounds and Injuries of the Kidney ... 261
Wounds ... 261
Injuries ... 268

CHAPTER XIV

Renal Calculus ... 268

CHAPTER XV

Tumors of the Kidney ... 277
Diagnosis ... 283
General Considerations and Treatment ... 285

CHAPTER XVI

The Surgery of the Kidney ... 288
Operations for the Exploration of the Kidney ... 291
Nephropexy ... 294
Nephrotomy ... 299
Nephrectomy ... 303
Decapsulation of the Kidney ... 315
Surgicial Treatment of Bright's Disease ... 316
Lavage of the Pelvis of the Kidney ... 318

CHAPTER XVII

Anatomy, Physiology, and Pathologic Anatomy of the Ureters ... 320

CHAPTER XVIII

PAGE
Surgery of the Ureters and for the Relief of Hydronephrosis.. 327

CHAPTER XIX

Anatomy, Physiology, and Pathology of the Bladder..... 343

CHAPTER XX

Diagnosis and Treatment of Diseases of the Bladder..... 355
Cystitis..... 356
Stone in the Bladder..... 364
Litholapaxy..... 368
Curettage of the Bladder..... 375
Suprapubic Cystotomy..... 376
Cystostomy..... 385
Treatment of Bladder Tumors..... 388
Exstrophy of the Bladder..... 397
Injuries of the Bladder..... 404
Rupture of the Bladder..... 405
Total Extirpation of Bladder..... 407
Hernia of the Bladder..... 408
Diverticula of Bladder..... 410

CHAPTER XXI

The Anatomy of the Penis and Male Urethra..... 412

CHAPTER XXII

Diseases of the Male Urethra..... 417
Urethritis..... 417
Symptoms..... 422
Diagnosis..... 424
Treatment of Non-gonorrheal Urethritis..... 427
Abortive Treatment..... 428
Treatment of Acute Anterior Urethritis..... 430
Treatment of Chronic Anterior Urethritis..... 435
Treatment of Acute Posterior Urethritis..... 438
Treatment of Chronic Posterior Urethritis..... 438
Résumé of the Treatment of Urethritis..... 440
Complications..... 441
Stricture of the Meatus in..... 453
Stricture of the Urethra in..... 454
Treatment for Retention of Urine and of Tight, Impassable Stricture..... 459
Rupture of the Urethra..... 472
Abscess of Cowper's Glands..... 474
Resection of the Urethra..... 476
Operations for the Relief of Urethral Fistula..... 479

CHAPTER XXIII

The Female Urethra..... 487
Anatomy..... 487
Congenital Malformations..... 488
Examination of the Female Urethra..... 489
Stricture of the Female Urethra..... 490
Dilation of the Urethra..... 491
Urethral Fissure..... 492
Peri-urethral Abscess..... 492
Urethritis..... 492
Tumors..... 494

CHAPTER XXIV PAGE

THE PENIS 497
Injuries 497
Growths and Ulcerations 499
Foreign Bodies and Calculi in the Urethra 501
Hypospadias 502
Epispadias 507
Amputation of the Penis 509
Phimosis 514
Paraphimosis 515
Circumcision 516

CHAPTER XXV

THE SEMINAL VESICLES 522

CHAPTER XXVI

ANATOMY, PHYSIOLOGY, AND PATHOLOGY OF THE PROSTATE GLAND ... 532
Anatomy 532
Physiology 533
Congenital Defects 533
Injuries 534
Hyperemia 535
Prostatitis 535
Hypertrophy 537

CHAPTER XXVII

DIAGNOSIS AND TREATMENT OF DISEASES OF THE PROSTATE 546
Acute Prostatitis 546
Chronic Prostatitis 547
Abscess of the Prostate 557
Prostatic Calculi 559
Prostatic Hypertrophy 560
Removal of the Prostate through a Suprapubic Opening 574
Tumors of the Prostate 587

CHAPTER XXVIII

ANATOMY AND PATHOLOGY OF THE TESTICLE AND EPIDIDYMIS 596
Anatomy 596
Pathology 599
Elephantiasis of the Scrotum 613

CHAPTER XXIX

THE TREATMENT OF DISEASES OF THE TESTICLE AND EPIDIDYMIS 617
Therapeutic Measures 617
Surgery of the Testicle and Its Covering 621
Operation for Hydrocele 621
Epididymectomy 627
Castration 628
Treatment for Inguinal Retention of the Testicle 631
Treatment of Atrophy of the Testicle 634
Treatment of Injuries to the Testicle 634
The Treatment of Varicocele 635
The Treatment of Tumors of the Testicle 637
Irrigation and Drainage of the Seminal Duct and Vesicle through the Vas Deferens 637
Treatment of Elephantiasis 639

CHAPTER XXX

NEUROSES OF THE SEXUAL ORGANS 640

INDEX 649

BOSTON MEDICAL
FEB 14 1918
LIBRARY

DISEASES OF THE GENITO-URINARY ORGANS AND KIDNEY

CHAPTER I

GENERAL EXAMINATION OF PATIENTS

The methods of examining patients who are believed to be suffering from lesions of the urinary tract are so diverse that the insertion of a chapter devoted to the discussion of these methods has seemed desirable. Undoubtedly much that appears here is already so well known as hardly to require mention. It is hoped, nevertheless, that those to whom the treatment of urinary disease is comparatively new work will find its perusal helpful. In our experience, errors in diagnosis are most often due to neglect in following a systematic method of examination.

The art of questioning the patients and of carefully interpreting the answers plays so important a part in the formation of a correct diagnosis in urinary diseases that it is well to cultivate a definite method in this division of diagnostic work.

A good plan to follow, after eliciting the necessary information regarding the family and personal history, is to question the patient concerning the symptoms complained of in the upper extremities, and so to continue on down the body to the soles of the feet. Although in a few cases, as for instance, that of a young man with a primary acute urethritis, it would be an unnecessary waste of time to go into the usual questions concerning the family history, diseases of childhood, and habits of life, still, in the majority of cases, a correct diagnosis can be made only after a thorough examination—both objective and subjective.

General questions should bear upon the family history. The cause of death of the various members of the patient's family should be ascertained, and the important subject of hereditary tendencies should receive full consideration. In this way a gouty diathesis, a tendency toward nerve derangements and toward early

arteriosclerosis, may be traced. Diseases of the nervous system are increasing at an alarming rate, hence information concerning hereditary tendencies toward the acquirement of nerve derangements are particularly significant in this connection when we remember how close a relationship exists between the condition of the nervous system and that of the urinary tract. Diseases of the former may give rise to functional diseased conditions of the kidney, the urethra, the bladder, the prostate, and the sexual apparatus. Certainly so far as the kidneys are concerned, and probably also to some extent with the other organs mentioned, nerve derangement may even be the direct cause of organic changes in them. Questions regarding a tendency toward early arteriosclerosis are of equal significance, certain American families displaying an astonishing leaning in succeeding generations to suffer from progressive changes in the arteries, such as cause apoplexy and various forms of paralysis. This is particularly noticeable among the wealthy, and seems to indicate that luxurious habits tend to produce early changes in the arterial system, whereas excessive nerve strain may give rise to some renal condition, such as interstitial nephritis, and thereby shorten the life of the individual.

Recent studies have shown beyond doubt that there is a very definite familial tendency in certain types of renal disease and particularly in chronic hypertensive nephritis.

Mendelism.—The rediscovery of the work done by Gregor Mendel, published in "Mendel's Principles of Heredity," by W. Bateson, M. A., F. R. S., V. M. H., 1913, of certain laws governing the production of plants, and inferences drawn from the observation of rat tumors as handed down from one generation to another, has stimulated work on the question of heredity, particularly as applied to malignant tumors. Definite knowledge of nature's laws in this respect has not yet been worked out, but enough has already been discovered to make the subject one of great interest and to emphasize the necessity of the utmost care being used in obtaining correct family histories for as many generations back as possible.

This matter will be referred to later in the discussion of malignant growths of the urinary tract, but is of so much importance that it should be noted here.

Personal questions can not be gone into too exhaustively, and it is well to have some definite plan that will insure against any important symptom being overlooked. The practitioner must be prepared here to meet a certain amount of obtuseness, for even individuals apparently well equipped mentally sometimes show an inability to answer intelligently the simplest questions concerning their past or present symptoms. In these cases, where the patient is suffering from some obscure conditions, long and patient questioning may be necessary.

Interrogate first regarding the presence of headache in its various forms—frontal headache, for instance, if not due to a diseased condition of the air-passages, is often associated with kidney lesions or perhaps with some chronic infectious or toxic process originating in the prostate, seminal vesicles, or elsewhere. Next inquire into the condition of the hair, and the acuteness of sight, hearing, taste, and smell. Ascertain also the condition of the throat, and inquire as to pain in the chest and shoulders, pain in the back, shortness of breath, and palpitation of the heart. Questions concerning the condition of the stomach and the digestion in general may elicit valuable information. Concerning pain in the abdomen or back, mere local pain, such as the well-known kidney colic, the pain extending along the course of the ureter, is generally due to calculus. In addition to this typical renal colic, it should be remembered that other diseased conditions of the kidney give rise to pain, which may start in the region of that organ and follow the course of the ureter. Diseased conditions of the kidney may give rise to pain in the lower extremities, and very frequently in the lumbar region. The most common type is the ordinary backache; this latter, however, is not diagnostic of diseased kidneys, and is very likely to be confused with some diseased condition occurring in the sacro-iliac synchondrosis. Zuckerkandl believes that a continuous pain in the kidney which is increased by pressure and is accompanied by sepsis, endocarditis, or myocarditis, associated with the passage of bloody urine, would warrant the diagnosis of kidney infarct. Pain in the kidney is generally believed to be relieved by rest in a horizontal position, whereas standing or moving about is said to increase it. This, however, is true not only of kidney

disorders, but is equally true of pain emanating from the kidney region due to disturbance of other organs or to certain forms of myalgia. Pain in the kidney is at times an indication of tuberculosis of the kidney, and when associated with blood in the urine is quite suggestive of this affection if otherwise unaccounted for.

The *condition of the bowel* should be definitely ascertained—whether there is constipation, whether defecation is accompanied by pain in the prostatic region, whether a discharge from the urethra occurs during defecation, and whether or not there is pain in the rectum.

Ascertain whether or not any present or past *acute urethral discharge* has been observed; whether pus is discharging from the urethra during the intervals of urination; whether a slight discharge appears with the first urine passed; whether there is a discharge of a thin, milky character following urination or defecation. A considerable amount of pus discharging between intervals of urination is generally due to acute urethritis. It may come from an abscess of the prostate or from an abscess of the perineal tissues. The same is true of any considerable amount of pus discharged at the beginning of urination. Discharges from the urethra following urination or defecation may be due to increased secretion from the urethral glands or to spermatorrhea, phosphaturia, or prostatorrhea. Shreds in the urine may be due to a previous urethritis or prostatitis. Discharges from the urethra may also be due to tuberculosis, and very rarely to a syphilitic involvement of the urethra, such as chancre. During pneumonia, rheumatic attacks, typhoid fever, or other infectious diseases pus may be excreted from the urethra. In the case of hematuria due to urethral lesions, we are inclined to believe that it will appear only in urethras that have been damaged, perhaps years before, by some acute inflammatory condition, such as gonorrhea. Regarding tuberculosis as a cause of purulent urethral discharge, we hold a similar view, for it seems to be well established that an antecedent gonorrhea predisposes to a subsequent tubercular infection.

Next, all possible information concerning *micturition* should be elicited. The force of the stream; whether or not pain is present during or after urination; whether the stream is interrupted or

suddenly checked, should all be inquired into, the answers to these questions bearing upon a diseased prostatic condition or stone in the bladder. Increased frequency of urination is a symptom in a large variety of conditions; it may point to diabetes, to increased ingestion of fluid, to polyuria (from some cause), to various forms of gravel, to disease in the upper urinary passages, to the influences of heat and cold, and to reflex irritation (in both men and women) from diseases of the neighboring organs. In young men it generally indicates some disease of the urethra; in the elderly, as is well known, it points to diseases of the bladder or prostate.

A *diminished amount of urinary excretion* or diminution in the frequency of its elimination may be due to an unusually small ingestion of fluid or to excessive perspiration or diarrhea, as well as to circulatory or real renal defects. The smallest amounts that we have observed passed by healthy subjects have occurred in cooks, stokers, and others whose occupation subjected them to prolonged exposure to heat, and who did not counterbalance the excessive perspiration by the ingestion of a proper amount of fluid. Zuckerkandl considers stricture and enlarged prostate as occasional causes of this condition; we believe that whereas they may occasionally be a cause of infrequent urination, the converse is more often true. Tabes and other disturbances of the spinal cord are also possible causes. The habit of many, particularly of women employed in manufacturing establishments, of refraining, for as long a time as possible, from answering nature's demand for the performance of this physiologic function is a common cause of this condition. It is unfortunately too true that proper accommodations are not always afforded to the employed, and that a sense of delicacy often acts as a factor. Continued overdistention of the bladder may later lead to the development of cystitis, and this may explain the reason why women are more often affected with cystitis than men.

Whether there has been a change in the *caliber of the stream* should be ascertained, although a correct conclusion can rarely be reached in this way. Change in caliber from the normal is ordinarily due to diseases of the urethra, such as stricture, which may lead to the ejection of a crooked or a forked stream. Diseases of

the prostate, nervous system, or bladder-walls may, however, give rise to a mere dribbling of urine. Here it may be well to mention that the careful anatomic investigations carried on by Ciechanowski on the amount of muscular tissue in the bladder-walls in healthy individuals show that in the aged there is a lessening in the amount of normal bladder muscle tissue; that in old men, as shown by accurate measurements, only about two-thirds of the amount of muscular tissue present in healthy adults exists. In children a long tight foreskin causes greater diminution in the caliber of the stream; in adults, increase in size of the meatus affects the caliber of the urinary stream. The force is also dependent, to a great extent, upon the condition of the nerves and muscles of the bladder and urethra, and upon the presence or absence of urethral obstruction. When the stream is suddenly completely checked, only to start again at full caliber, stone in the bladder is generally indicated. If prostatic obstruction exists, the stoppage is more gradual, ending in a sort of dribbling. Other bladder lesions besides stone may probably give rise to sudden stoppage of the flow. It has been observed in old men the trabeculæ of whose bladders were thickened and in whom repeated examinations failed to elicit the presence of stone.

The question as to whether or not pain accompanies urination may not furnish much information, owing to the marked differences regarding sensitiveness to pain that exists between various individuals. Those suffering from neurasthenia or hyperesthesia of the deep urethra may complain of painful micturition; whereas those suffering from marked organic disturbance in the urethral canal may not. Some writers believe that pain occurring at the beginning of urination indicates disease of the urethra and prostate, and that pain at the end indicates disease of the bladder. Pain in the bladder between the acts of urination may indicate stone, tumors, or pus-formation in the prostate. Concentrated urine and the passage of gravel, as is well known, will give rise to pain and disease of the bladder. Pain is most prolonged and marked in the bladder region in acute cystitis, which may be associated with tuberculosis or tumors, more especially those of a malignant type. Tumors of the prostate, particularly cancer, exhibit pain in the prostate as one of their most characteristic

symptoms, but this does not necessarily give rise to painful micturition unless the disease has advanced beyond the prostatic capsule. Pain in the glans penis is often caused by stone in the bladder, and is less often associated with cystitis or gravel, which gives rise to painful urination. Marked neurasthenics are occasionally subject to spasmodic attacks of tenesmus, which occur in the day-time, never at night, last for an hour or two, and pass away. These attacks resemble those occurring from gravel. As a general rule, gradual recovery follows. The origin of these attacks is, at the present time, unknown.

An inquiry into urinary *retention*, partial or complete, may elicit valuable information. Complete retention is in most instances due either to stricture, more apt to occur in early life, or to an enlarged prostate, the latter being usually the case in the aged. Rupture of the urethra, coagulated blood in the bladder, and various forms of apoplexy and paralysis may cause retention. It also frequently follows a surgical operation for hemorrhoids, gynecologic operations, or excessive tamponade. A condition of chronic retention may be caused by overdistention of the bladder and by hypertrophied prostate.

Incontinence may be due to acute urethritis and to prostatic disease; almost any injury of the muscles about the neck of the bladder may act as a cause, and in children it is often seen as the result of inefficient innervation. New-growths and diseases of the spinal cord are also causes. Suprapubic, urethrorectal, or perineal fistulas occurring after operations or as a result of tuberculosis may give rise to this condition. It more frequently follows a suprapubic or a urethrorectal than a perineal fistula.

Questions should be asked concerning the *gross character of the urine passed*, whether its color is normal, dark, light, bloody, black, or milky. In diabetes, nervous conditions, and chronic diseases of the upper urinary tract straw-colored urine is the rule. Black urine, or that which becomes black after standing a short time, is frequently due to the ingestion of carbolic acid or other hemolytic substances, but occasionally it is due to the formation of a substance called melanin; this last renders the urine cloudy, with the deposition of black, sooty particles, as onchronosis. When the urine is bloody, it may be of a dark hue, and is then probably due to hemor-

rhage in the upper urinary passages. Clot formations in the ureter, passed out in the urine, and resembling earthworms, are diagnostic of renal hemorrhage. Bloody urine is often, of course, due to disease of the bladder or ureter; fresh colored blood in the urine is usually the result of disease of the urethra. Blood is seen in the urine after certain forms of trauma, stone, after the ingestion of various drugs, such as cantharides, or as an accompaniment of infectious diseases, such as typhoid fever and malaria. Malarial fever may not infrequently give rise to hematuria. Blood in the urine may be the first symptom of tuberculosis of the urinary tract, especially of the kidney. Milky colored urine may be due to the admixture of pus or to phosphaturia or chyluria; and thick, brownish-colored urine to the presence of urates. Filaria and various forms of parasites may give rise either to bloody or to chylous urine.

The history of *previous diseases* should be thoroughly inquired into, since such diseases as scarlatina, syphilis, or even previous attacks of urethritis cause changes in the kidneys. A knowledge of the habits of the patient's life, his occupation, and the climate to which he has been accustomed will also be of assistance not only in the making of a correct diagnosis, but also in indicating the prognosis and formulating the treatment. All observers are agreed as to the difficulty in effecting a cure in so common a condition as urethritis in persons subject to much vibration, such as railroad employees or automobilists experience.

Occupational diseases, as a whole, are thrusting themselves forward for consideration with increased frequency owing to the complexity of life, and may be responsible for marked changes in the urinary system.

Geographic Conditions.—Owing to the marked diversity in the habits of life in different localities as regards food, drink, and in the character of fluids ingested, a knowledge of these facts is necessary. Due to immigration these facts are of very real importance in this country. Diabetes and stone formation, for example, may be mentioned in this connection. Observations are being more and more frequently recorded of the effects of microbic infection, usually confined to certain geographic areas, as, for example, in the relapsing fevers. Filaria sanguinis hominis is extremely com-

mon in Porto Rico, and in certain parts of South America is an illustration of this. It causes among other lesions marked, diversified, and interesting changes in the urinary organs, as well as being one of the principal causes of elephantiasis. This subject is again referred to further on under Diseases of the Testicles.

Information can also be obtained by inquiring into the *sexual life* of the patient, and the importance of the numerous, though frequently minor, sexual perversions is obvious.

These manifold questions demand painstaking effort on the part of the examiner; but if while so doing he is able to encourage the confidence of his patient and if his judgment is sufficiently keen and his faculties in general are sufficiently discriminative to enable him to ascribe the proper clinical import to the facts elicited, the diagnosis, which often can be reached in no other way, will be sufficiently accurate to reward his efforts.

General inspection of the patient may follow the questioning. His actions and the manner in which he replies having previously been noticed, his body should now be carefully examined. In some diseases of the kidney, bladder, and prostate the hair presents a dry and brittle appearance that, once seen, is easily recognized. In secondary syphilis, round patches of alopecia are frequently seen. Any eruption on the face, neck, or trunk, old scars, and growths may all tell their tale. Disturbances of the pupil may be indicative of locomotor ataxia, which is often mistaken for some disease of the urinary apparatus, an error that should be guarded against. The condition and shape of the teeth may show the result of hereditary syphilis. Important aid may be obtained from studying the color of the lips, a bluish hue indicating possible venous stasis, polyglobulism, mitral disease, etc. The position of the apex-beat of the heart, especially if it occurs below or to the left of the normal point, is well worth ascertaining. The cremasteric, knee-jerk, and ankle-clonus reflexes should be tested. The power of coördination should be investigated by the simpler tests, such as having the patient stand with his eyes closed and his heels and toes together and bringing the index-fingers in apposition. Cases of disturbed urinary function difficult of diagnosis have been brought under our observation in which the increased knee-jerk reflex seemed to eliminate locomotor ataxia and in which the

patients were not neurasthenic, the increased reflexes afterward proving to be due to a myelitis that preceded the onset of locomotor ataxia. Undoubtedly many somewhat similar cases are confounded with organic disease of the urinary tract, the practitioner failing to grasp the significance and seriousness of the existing nervous symptoms. Involuntary muscular contractions should be inquired into. A tendency to lift one leg is often indicative of abscess formation on that side, and is associated frequently with pyelonephritis.

A **physical examination** by means of percussion and palpation, and an examination of the secretions should now be made before proceeding to instrumental examination. It is very often possible, as the result of questioning alone and through a process of exclusion, to arrive at a fairly accurate diagnosis. The physical examination of the kidneys is elsewhere considered, but will be merely alluded to here. Casper states that by percussion it may be possible to diagnose a kidney tumor from an intestinal tumor, as the latter gives rise to a tympanitic sound; personally, we have not been able to obtain much information from percussion. The statement, so widely believed, that a kidney tumor will fall backward when the patient is lying on his back, with pelvis and legs lifted, is a method of differentiation that we have also found of no use. Clinically, we have found that tumors of the kidney can be accurately differentiated from those involving neighboring organs only by exploratory operation. However, palpation with percussion will often be the means of determining the presence or absence of tumors of the kidney or neighboring organs. In order to obtain the best results from palpation of the kidney the patient should be on his back, with knees flexed, but avoiding all tension of the abdominal muscles; the examiner should place one hand beneath the back and press upward between the crest of the ilium and the last rib; the other hand should be placed directly over this, and press downward on the abdominal wall. A similar procedure may be carried out with the patient lying on one side or standing and bending over a chair.

As mentioned in the chapter on the Kidney, it is well to massage and manipulate the abdomen, following the course of the

ureter in the case of suspected pyelonephritis; as a result of this manipulation pus or an increased amount of it will be noticed in the urine. Pyelonephritic kidneys are usually tender on pressure, although it is sometimes difficult to determine whether the tenderness is due to a diseased kidney or to some other condition, such as the result of injury or arthritis of the sacro-iliac synchondrosis.

Percussion and palpation of the bladder region are occasionally of value. It should be remembered that patients suffering from prostatic hypertrophy may have thickened bladder-walls, or, as a result of retention, the bladder may be much distended. This latter condition, together with a thickened bladder-wall, we have known mistaken for an abdominal tumor. In any one, male or female, even if no history of retention has been given, in whom the presence of an abdominal tumor is suspected, unless its nature can be very clearly determined by other means, it is well to catheterize the bladder and study the results. The groins should be palpated to ascertain the presence or absence of hernia. Retained testicle should be looked for, and the general appearance of the genital organs observed. The condition of the foreskin should be learned, and disease of the testicle or ulceration of the scrotum looked for. The nature of the scrotal contents should be ascertained, for it should be remembered that tuberculosis is prone to cause early invasion of the testicle or epididymis.

An examination of the heart will reveal any tendency toward enlargement, either from the dilatation or the hypertrophy so closely associated with kidney disease. The pulse, either with or without sphygmographic tracings, will give some conception of the amount of arterial pressure or as to the extent of arterial disease. The temperature will indicate the presence or absence of fever, which may, perhaps, have its origin in the urethral canal.

Urinary fevers may be divided roughly into three classes:

1. There is a continuous form that comes on a few hours after catheterization, rupture of the urethra, or some form of trauma; it is generally inaugurated by a chill, followed by high temperature, which subsides in a day or two at the most, when convalescence ensues. Occasionally this fever is of a fulminating character, the

temperature remaining very high, death sometimes occurring in a comparatively short time.

2. The second form of urinary fever is intermittent in character, with only a slight rise in temperature, followed by a return to the normal, and then another rise; clinically this resembles mild malarial fever. It may be due to injury caused by improper instrumentation, or it may be associated with the presence of pus in the prostate, kidney, bladder, or elsewhere.

3. The third class is of a remittent type, the temperature, while not high, never reaching the normal until convalescence. Just as in gangrene of the appendix or other organs, it occasionally happens that an abscess in the urinary tract may cause such profound sepsis as to result fatally without exhibiting a rise in temperature. We have met such a case due to a large abscess in the prostate, and this character of temperature course seems to be particularly frequent in unruptured prostatic abscess.

In most fatal cases of urinary sepsis attended with fever postmortem examination reveals multiple abscesses of the kidney. When death has resulted directly or indirectly from stricture or from prolonged retention, the postmortem shows that dilatation of the ureters takes place, that the pelvis of the kidney has become infected, and that multiple abscesses have formed in the kidneys as the terminal process in the disease.

The **examination of the prostate** may profitably be postponed until after instruments have been passed into the urethra, should the diagnosis necessitate the latter measure. By observing this rule the danger of urethral infection is somewhat lessened. But when instrumentation is not to be resorted to, the examination of the prostate may terminate the general physical examination. A thorough examination of this gland can best be made with the finger in the rectum after an instrument has been placed into the bladder and allowed to remain there; this affords a means of estimating the distance between the finger and the instrument. The ordinary procedure for prostatic examination through the rectum is to have the patient bend over a chair or a table; the examiner introduces the forefinger of the right hand, covered with a well-lubricated finger-tip, into the rectum, and searches for any enlargement or thickening of the prostate or of the seminal vesicles.

Any difference between the two lobes can be ascertained at the same time, also any points of softening that might be indicative of a prostatic abscess. When the latter condition exists, a sort of dimple will probably be present in the prostate. When the abscess is extensive, slight massage of the side of this dimple may cause pus to exude from the meatus. Should the patient urinate

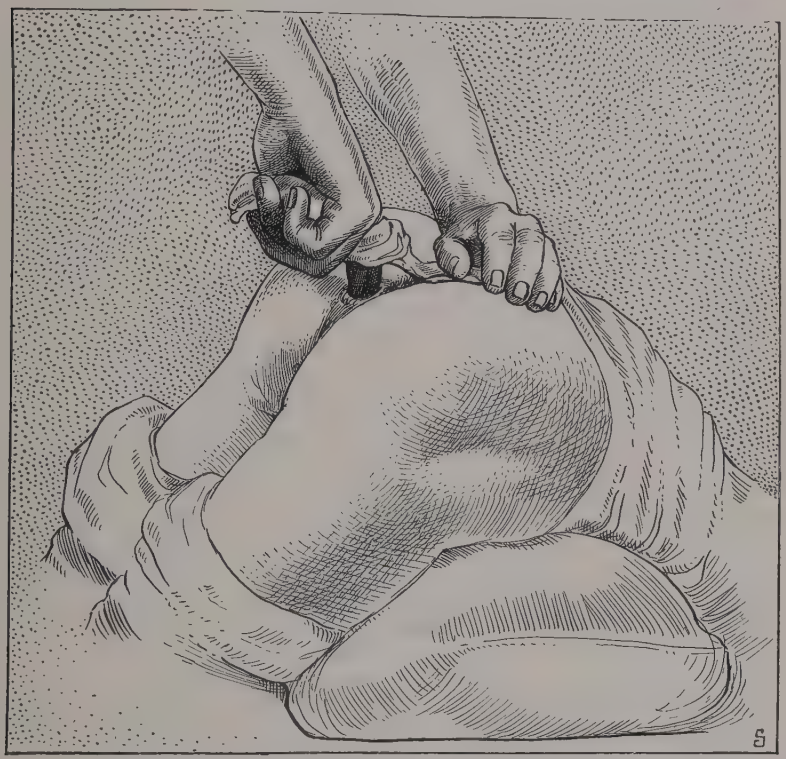


Fig. 1.—Examination of the prostate by the rectum only. Also position for massage of the prostate.

after the massage, if abscess of the prostate is present, the urine will usually contain large quantities of pus. When the seminal vesicles are enlarged, they will ordinarily be found to run off like cords, at an angle with the apex of the prostate, forming with it a triangle whose base is the base of the bladder and whose apex is the prostate. Massage may also be applied to the seminal vesicles and to the prostate for the purpose of obtaining their contents for

microscopic examination and for the purpose of locating painful areas.

With thin male subjects it is well, besides examining the prostate through the rectum by the method previously suggested, to place the patient on his back, and to introduce the forefinger of the one hand into the rectum and, with the other hand on the abdomen, to press down over the suprapubic region. Considerable experience is necessary to correctly diagnose diseased conditions of the prostate or seminal vesicles by means of rectal examination alone, no instrument at the time being present in the bladder, and we find that even intelligent members of house staffs in hospitals are repeatedly making mistakes as to the findings derived from that procedure and drawing false conclusions from it. The mistake most frequently made is that of supposing an enlargement of the prostate or seminal vesicles to exist when none is present. Information concerning a stone in the bladder can rarely be ascertained by rectal examination, and still more rarely is it possible to learn the condition of the ureters in the male by this method.

In women a **vaginal examination** may give considerable information as to the condition at the base of the bladder, and when made bimanually, as to the condition of the ureters.

An examination of the secretions is the next step in order, and it is best that this be made, in part at least, at the patient's first visit. When tuberculosis is suspected, prolonged examination is necessary to detect the presence of the tubercle bacillus with absolute certainty, and some time must elapse before the diagnosis can be arrived at. Other conditions, however, may be more summarily dealt with. In cases of acute urethritis the discharge may be washed out from the urethra as far as the bulb, and the urine may then be passed and collected for examination. After this process the bladder may be washed out, emptied, and, if thought advisable, the prostate massaged, and an attempt at urination made. A few drops of this urine should be preserved for a future examination, in order to ascertain the condition of the prostate and seminal vesicles. In those individuals in whom no acute dis-

charge is present, washing out of the anterior urethra will be unnecessary; the patient should, however, be requested to urinate, and the urine be set aside for examination or a simple examination immediately made.

We have found some of the *glass tests* advocated for the purpose of locating the seat of urethritis to be misleading. One of these fallacious tests is to have the patient pass half the urine into one glass and half into another. If the urine in the second glass is clear, whereas cloudiness or shreds are present in the other, this has often been thought to prove conclusively that the inflammation is confined to the anterior urethra. This test has been proved to be unreliable, since if but a slight amount of discharge were present, it could be washed out with the first half of the urine passed, even when the inflammation extended, as it usually does, throughout the entire urethral tract. The test may, however, have a relative value if made when a large amount of urine is in the bladder, as on the first urination after rising. If both glasses are then found to be cloudy, and the patient is asked to urinate in the same manner later in the day, when the bladder contains but a small amount, and all the cloudiness is found to be confined to the first glass, this would indicate the existence of a posterior urethritis; if, however, then neither glass is clear and the cloudiness is seen microscopically to be due to pus, or the shreds to be made up of pus-corpuscles, a cystitis or kidney involvement would be demonstrated. If the early morning urine is collected in three glasses and all are found to be cloudy and to contain pus or numerous shreds, it indicates, generally, that the inflammation is beyond the posterior urethra. These various glass tests will be referred to again under the Diagnosis of Urethritis (p. 425).

The chemic examination of the urine is dealt with in more detail elsewhere (p. 112), but there are several valuable simple tests for learning some of its possible constituents that may be made expeditiously at the time the patient is being examined. Cloudy urine is ordinarily due to the presence of mucus, pus, bacteria, urates, phosphates, carbonates, or albumin; a simple test for determining to which of these agents the cloudiness is due has been outlined by Ultzmann, of Vienna. A portion of the urine

is placed in a test-tube and the upper portion boiled. If it immediately becomes clear, the cloudiness is due to the presence of urates; if it becomes more cloudy, to phosphates, carbonates, or albumin; and if it remains unchanged, to pus or mucus. If, then, by adding a drop of dilute acetic acid to the urine it is immediately clarified, the cloudiness was due to an excess of phosphates; and if, in addition, it effervesces in clearing up, it was due to carbonates. If it becomes still more cloudy, albumin is present, and if it remains unchanged, pus, mucus, or bacteria may be said to be present.

A very popular test for mucus or pus is to add an equal amount of liquor potassæ to the urine in the tube; shake the tube well, and if the mixture shows considerable cloudiness, particularly if of a stringy character, the presence of pus or mucus may be said to be established.

It is hardly necessary to state that when the presence of any of the above-mentioned substances has been detected, these tests must be further confirmed by means of more accurate methods.

THE INSTRUMENTAL EXAMINATION

The verbal and physical examination of the patient having been completed and the urinary and other secretions of the body having also been examined, it is often necessary, in addition, as previously mentioned, to complete the examination by the introduction of some instruments, such as a catheter, bougie, sound, searcher, or possibly endoscope or cystoscope, into the urethra or bladder. A detailed description of all these instruments is unnecessary; the following are those that have given the most satisfaction in the writer's hands. For ordinary purposes of catheterization, the soft-rubber, velvet-eyed catheter is probably the form most generally used. The smaller catheters are to be preferred to the larger. No catheter should be used ordinarily that has any hole besides the eye, and care should be taken that there are no rough places on the instrument that might scratch the urethra—particularly, that there is no roughness about the eye. Often, after very little use, the edges of the eye of the catheter become roughened. This should be particularly guarded against where the services of a physician or of a trained attendant cannot be procured, and where the patient must be taught to use the

instrument himself. The shafts of these catheters, as ordinarily made, are round. Soft-rubber catheters, somewhat flattened at the lower end, have recently been put on the market. They are said to be useful in cases of enlarged prostate; the urethra being stretched by the prostatic enlargement, is necessarily generally narrowed from side to side, and a catheter somewhat flattened on the side will thus more easily conform to the shape of the canal. They are also made flattened at the top and the bottom. Soft-rubber catheters have very little penetrating force, their introduction being easily hindered by stricture of the urethra; in cases of enlarged prostate, moreover, where the prostate alters the natural curve of the urethra, they are particularly likely to curl up at the bulbomembranous junction. They are also introduced with difficulty if a spasm of the urethral muscle—a so-called spasmodic stricture—exists.

Catheters of gummed linen or silk with flexible olive ends preceding the entrance of the eye are extremely useful, when properly constructed. They are of value not only for the ordinary purpose of a catheter to empty the bladder, but are useful for examining the urethra in both its anterior and its posterior portions, as the flexible bulbous point very easily detects any irregularity in the canal. Then, too, they are useful as a means of making applications to the posterior urethra and bladder. In choosing catheters of this description great care should be exercised. As ordinarily made in this country, the olive-pointed ends are too inflexible, and the catheters partake too much of the nature of an Indian arrow. Such instruments are likely to do more harm than good. When the ends are extremely flexible, however, they are useful in overcoming urethral obstacles, such as strictures of not too small caliber; they are more useful than soft catheters in overcoming spasms at the neck of the bladder, and if flexible enough and not too large, will not irritate the urethra. Ordinarily they can be introduced into the bladder with less pain to the patient than any other form of catheter. For emptying the bladder, where this must be done rapidly, they are not, as a rule, so serviceable as some others, and in old prostatics, with large quantities of residual urine, or in cases where a large amount of fluid is to be evacuated from the bladder, they may not be found so prac-

tical as the soft-rubber catheters or those of some other shape or material, on account of their comparatively small lumen. Ordinarily, they may be procured in two forms—those whose upper extremity is of the same circumference as the shaft, and those in which the upper extremity is funneled, in order that the fluid may be more easily injected through them by means of the nozzle of a syringe. For this same purpose a small piece of rubber tubing may be attached to the upper extremity and the nozzle of the syringe introduced into this. These have been found more useful than any other instrument for the purpose of irrigating the deep urethra and the bladder. The best of these instruments are those made in France. The most practical for use are Nos. 10 and 12 French.

Being unirritating, they are useful for purposes of irrigation where it is desired to introduce quite a large quantity of fluid along the floor of the posterior urethra and into the bladder. They are also very useful for purposes of instillation—that is, the process by which a few drops of fluid, generally some strong solution, are applied to the neck of the bladder.

The uselessness of a multiplicity of instruments has often been proved. Clinical experience has demonstrated that these simple bulb-pointed flexible tipped catheters are useful for purposes for which many different forms of instruments are advocated. Silk gum catheters with stylets—the stylet being introduced for the purpose of making them unyielding and permitting them to be bent into any desirable shape—have often been used in the past and are still recommended by some as the best form of catheter for use by old men who are obliged to use one constantly. Their value has probably been very much overrated. An ordinary soft-rubber catheter is the safest one for the individual to use on himself. When, because of malformation of the prostate, the soft catheter cannot be made to penetrate, one of the larger sizes of the French olive-tipped flexible catheters, just described, should be tried. That failing, one of the particular shape best adapted to overcome the particular form of prostatic obstruction present should be used.

There are three forms of these catheters: the "Mercier coudé," "bicoudé," and the large prostatic curve (see figs. 2, 3, 4, 5). The instruments with the large curves are ordi-

narily made of metal, and the smaller are made of either metal or silk. The simpler curves, such as the "Mercier coudé,"

Fig. 2.—German silver metal catheter, with ordinary urethral curve.

should first be tried in an endeavor to pass through an obstructed prostatic urethra; if these fail to pass, the "bicoudé," or the cath-

Fig. 3.—Mercier's coudé catheter.

eter with the large prostatic curve, may be tried. Often a metal catheter with the ordinary normal urethral curve will be found

Fig. 4.—Mercier's bicoudé metal catheter.

useful. It is advisable to keep on hand a series of metal catheters of the following four types: "Normal curve," "Mercier," "coudé,"

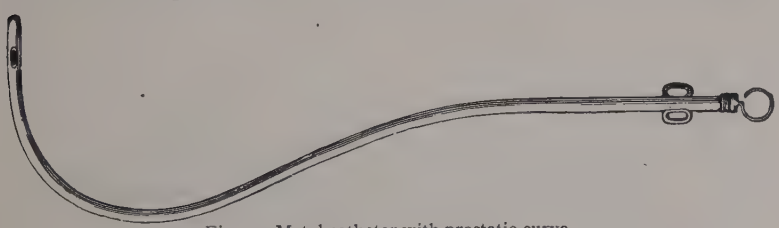


Fig. 5.—Metal catheter with prostatic curve.

"bicoudé," and large "prostatic" curve. The use of retention catheters is coming into increased favor. They usually consist

of an instrument with a collar, the Pezzer retention catheter (fig. 7), or a catheter with a wing on each side, the Malécot retention catheter (fig. 8); the catheter being introduced into the bladder, the collar or wing prevents its escape unless some ilttle traction is used by the attending surgeon. An ordinary

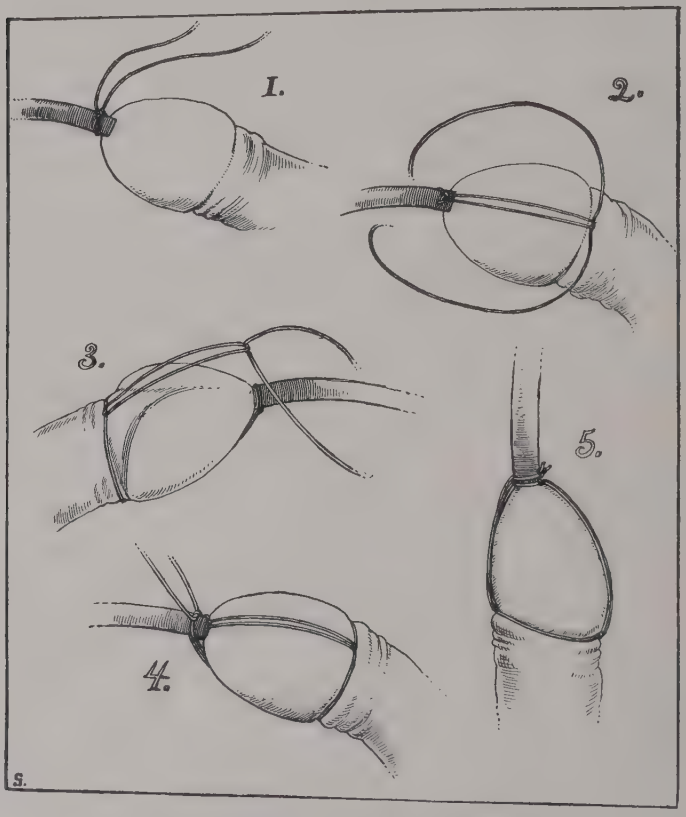


Fig. 6.—Method of tying catheter in bladder.

catheter may be held in place in the bladder by fastening linen threads around the glans, or by the use of adhesive plaster. These retention catheters sometimes remain in place for a period of two weeks without necessitating removal or causing much irritation. It not infrequently happens that in those cases in which it is

most desirable that a catheter be retained, as after operations on tubercular subjects, this will not be found feasible. A retention catheter must generally be eventually removed because of the local irritation it produces inside the bladder at its neck; its pressure sometimes sets up a general urethritis.

Zuckerkandl[1] considers that a retention catheter can be retained longer without causing irritation, the urethra being better protected from infection from the outside if a spica bandage, com-

Fig. 7.—Pezzer retention catheter.

mencing at the base of the shaft of the penis, is wound around it to the glans, over the glans, and for an inch or two on the shaft of the catheter, the other end of the catheter being run through sterilized cotton in the neck of the bottle or other receptacle that is to receive the urine.

Bougies are instruments made of gummed silk or linen, and are used for the purpose of examining the urethral canal or for dilat-

Fig. 8.—Malécot retention catheter.

ing strictures. Filiform bougies, so called from their minute size, are ordinarily used as guides to effect an entrance into the bladder in cases of retention from stricture of the urethra. Ordinarily they are made of whalebone, although the very small ones recently introduced are made of catgut. These catgut bougies are useful little instruments, for by this means the bladder may be entered

[1] "Die Asepsis in der Urologie," Friesch and Zuckerkandl, "Handbuch der Urologie," Vienna, 1904.

when all other forms of bougies have failed. They are not, however, ordinarily required, and are very easily so damaged as to unfit them for use. The filiform bougies made of whalebone are generally put up in different lengths, the longest being twice that of the short ones. Where it is impossible to obtain the assorted lengths, the long ones should preferably be kept on hand. In cases of stricture in a long urethra, after introducing a short bougie into the bladder it occasionally happens, if an attempt is made to run a tunneled sound over it, that the upper end of the bougie, if a short one is used, will be carried into the urethra, beyond the meatus. Whalebone bougies have small flexible rounded points on their ends; others end with straight points, and still others are twisted. The choice of these for general use is depen-

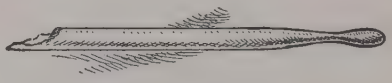


Fig. 9.—Olivary gum bougie.

dent on the surgeon's preference; ordinarily, when it is possible to pass them, the round-tipped ones are to be preferred. A filiform bougie, made of whalebone, of the ordinary circumference of the filiform at the lower extremity, but with a long shaft gradually increasing in circumference, has been on the market for several years under the name of the Banks filiform, or whip bougie. Experience with this instrument has demonstrated that, being made of whalebone, it is not flexible enough to possess much advantage over the ordinary filiforms. To overcome this, Tiemann & Co., of New York, have, at our suggestion, had instruments made in Paris of the same shape as the Banks bougie, gummed silk taking the place of whalebone. These instruments are found to be much more flexible and useful, and are recommended as a useful addition to the surgical outfit of the general practitioner. In cases of stricture, the flexible point having passed the strictured portion, it is only necessary to keep pushing the instrument down through the urethra—the lower end of it will double up in the bladder until the largest part of the circumference has passed the strictured portion, thus dilating the stricture. Following the removal of

this instrument a silk, olive-pointed bougie of small caliber can ordinarily be passed. These olive-pointed silk bougies may be obtained in the various sizes up to No. 20 French or larger. They are useful for dilating strictures of small caliber, but should not, ordinarily, be used of a circumference larger than the No. 20 French; when it is desired to dilate through a larger opening, metal instruments should be substituted. In choosing these bougies it is always well, as previously stated, to obtain those with the most flexible neck, thus lessening the danger of inflicting injury on the urethra.

Bougies à boule are used for examining the urethral canal. They may be had in varying sizes. They are made of either rubber or metal, the former being preferable, and are useful for locating

Fig. 10.—Otis' metallic bougie à boule.

any foreign masses or other constricting lesions that may exist in the anterior urethra; they are also useful for diagnosing the various forms of stricture that may occur there. An obstacle having been met, the largest bougie à boule that will pass the obstacle can be introduced through the urethra; if the next size larger will not penetrate, a correct idea may be had as to the circumference of the urethra at the strictured portion. These instruments are not to be recommended in the treatment of disease, and it is not advisable, ordinarily, to use them for diagnostic purposes or for detecting or treating lesions beyond the bulbomembranous junction. For ordinary diagnostic purposes the flexible olive-pointed gum bougie previously described is preferable.

Various ingenious contrivances have been devised for accurately measuring the circumference of the anterior urethra. These instruments, with the exception of the bougies à boule previously mentioned, are known as *urethrometers*. The only one that will be described here is the Otis urethrometer, which was designed by the late Dr. Fessenden D. Otis, of New York. It fulfils the pur-

pose for which it was designed so well that any description of the various other instruments, mostly of foreign make, invented for this purpose is needless.

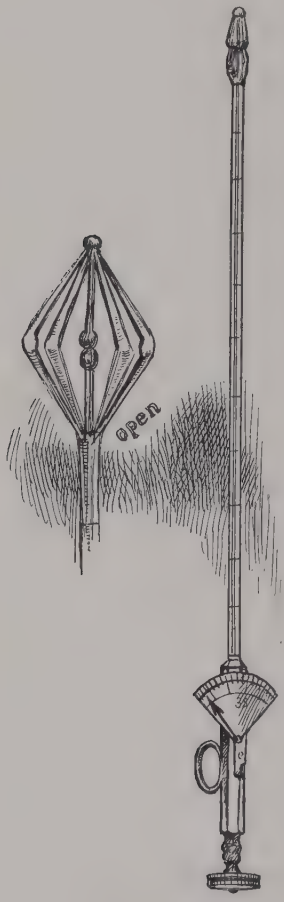


Fig. 11.—Otis' latest urethrometer.

The instrument, with the end of the shaft closed, is passed through the strictured portion of the urethra and distended until it cannot be withdrawn because of the obstacle in front of it. The index on the dial plate will show the circumference of the urethra at the strictured portion. The end can then be contracted enough to allow the strictured portion to be passed, and later again, as the instrument is withdrawn, distended to show the presence and size of any other strictured portion that may be met.

Sounds are steel instruments varying from Nos. 10 to 40 French scale, and ordinarily used for distending the urethra in the treatment of stricture; they are also introduced for their general effect in relieving hyperemic or chronically congested conditions of the mucous membrane of the urethra: this is accomplished as the result of pressure. The numbers most ordinarily used are from No. 15 to No. 35 French. These sounds are obtained with curves varying as regards either their form or length. The several different forms of curve ordinarily on the market have about the same degree of usefulness. Every surgeon's outfit should contain a few sounds with the so-called Benique curve, which are particularly useful in cases of enlarged prostate. Sounds having the Guyon curve are, for ordinary purposes, probably as good as any that can be procured. The blunt-pointed sounds now on the

market are undesirable, there being very little difference in their size from their extreme end to their full circumference. Experience has proved that such sounds are much more difficult to introduce into the bladder than those of tapering form. It must be remembered that a sound must answer the purposes of a wedge to a considerable extent, and it should, therefore, be shaped accordingly.

Straight sounds may also be had, and are used at times for distention of strictures of the anterior urethra.

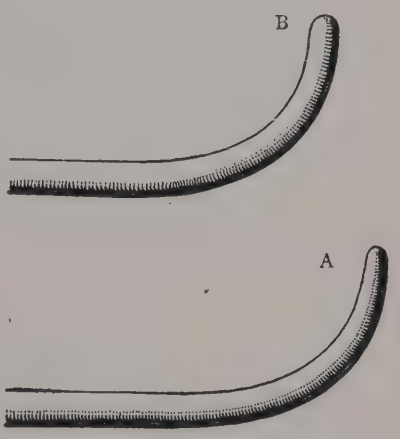


Fig. 12.—Showing proper (A) and improper (B) conicity of sound.

Searchers are instruments used for detecting the presence of stone and tumors in the bladder, and for obtaining a general idea of the topography of the bladder, prostate, and urethra. They are made in various shapes and forms, but the Thompson searcher is the one most generally used. Hollow searchers answer the purpose of metal catheters. Their use is described in detail in another portion of the book. In purchasing searchers care should be taken to see that the plug at the upper end is well fitted in and is secured to the end of the searcher by a chain.

Fig. 13.—Thompson's searcher.

Short straight sounds of large diameter are useful for keeping the meatus distended after meatotomy has been performed. Instruments, such as the cystoscope and the endoscope, which are useful for examining the urethra, under direct or artificial light, are described in detail elsewhere.

Glass *syringes* may be had in several different forms, having ordinarily a capacity of from four to six ounces; the advantage of these is that their contents are visible. For general urethral

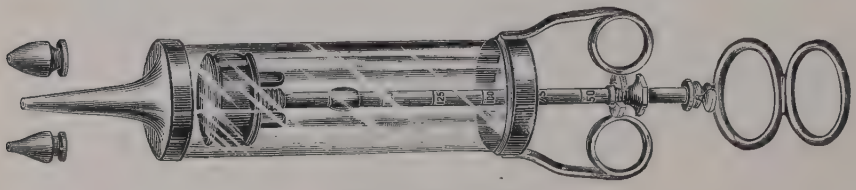


Fig. 14.—Janet syringe.

purposes, however, metal syringes, some of which are so made that they can be easily taken apart and sterilized, are the most useful.

Fig. 15.—Janet syringe.

For the patient's own use, blunt-pointed glass syringes with or without rubber ends are useful.

For bladder irrigation the syringe with a large rubber bulb

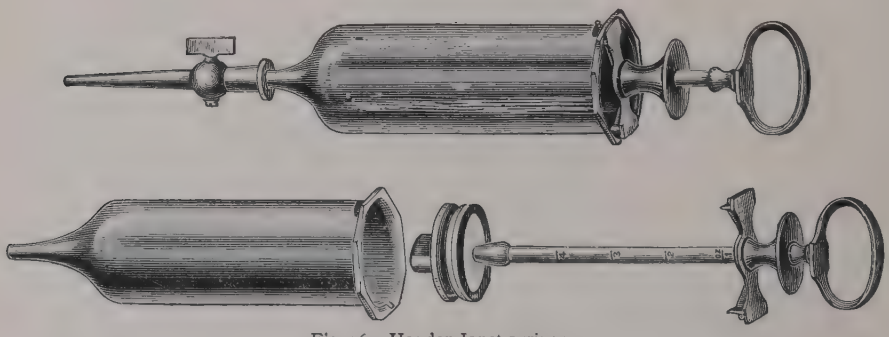


Fig. 16.—Hayden-Janet syringe.

and stop-cock, as illustrated in Fig 17, is the one that will be found most convenient for the patient's own use, where an enlarged prostate gives rise to the necessity for catheter life.

In addition, there are various forms of instruments, some of which are to be attached to the syringe especially designed for making applications to the deep urethra. The two best

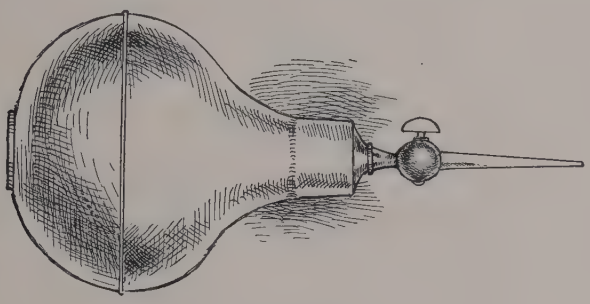


Fig. 17.—Rubber bag and stopcock for injecting.

known of these are the Ultzmann syringe, for instillation, and the Ultzmann metal catheter for irrigating purposes.

Instruments to be used for similar purposes have been devised by Guyon and many others. Experience has proved that, either for instillation or for irrigation, as good results can be obtained

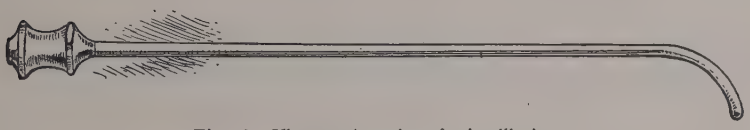


Fig. 18.—Ultzmann's syringe for instillation.

from the use of the ordinary flexible, olive-pointed silk catheter of small caliber.

CATHETERIZATION

In the chapter on the Sterilization of Instruments and the

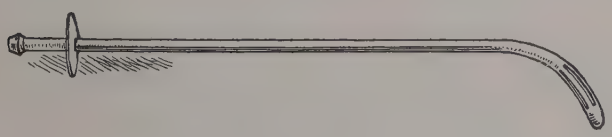


Fig. 19.—Ultzmann's irrigator for deep urethra.

Preparation of Patients for Operation the question of sterility as regards instruments and the field of operation in catheterization is considered more in detail (p. 90), for, after all, it is well, as has

been stated by other writers on the subject, to regard catheterization as an operative measure. It should be constantly borne in mind that as the urethra is the natural habitat of organisms capable of setting up inflammation when an opening offers from any traumatism that may occur there infection is liable to arise, hence the necessity of observing all possible precautions to render the field and the instruments sterile. More with the view of refreshing the reader's memory than from a desire to improve upon the directions given in many text-books on surgery as to the manner in which a urethral instrument should be passed, the following description is given:

In order to properly enter the bladder, the catheter, bougie, or sound must, after the instrument passes the bulbomembranous junction, correspond in shape to this curve. The steel and some of the silk instruments already mentioned are curved before using, following either the normal curve, or being made to correspond to any deviation from the normal curve of the urethra, such as might be caused by an enlargement of the prostate. The straight instruments, being flexible, are made to assume the proper curve by the pressure from the urethra in its curved portion. The pendulous urethra, being straight from the meatus to the bulbomembranous junction, a straight instrument, if flexible, will penetrate as far as the bulbomembranous junction, but after this point is passed, and we get beyond into the remaining portion of the urethra to the bladder, a fixed canal is encountered. This being the case, it should be borne in mind that both the flexible and the fixed urethra must be so dealt with as to cause the least possible irritation, and also that the beak of the instrument, having entered the bladder, is not to be pushed so far back into the bladder as to cause injury to the posterior bladder-wall.

In passing a straight flexible instrument, the field having been properly cleansed and the instrument lubricated, it may be introduced with the patient either lying down or standing, the operator standing on either side of the patient, as may seem most convenient. The instrument is passed easily in as far as the bulbomembranous junction, at which point, ordinarily, some slight resistance is met. Individuals of the neurotic type are extremely likely to exhibit sensitive points in the anterior ure-

thra, even if little or no organic disturbance exists there. Under such circumstances pain will be considerably lessened by using a generous amount of lubricant, and passing the instrument very slowly; by grasping the glans penis and extending the urethra, and at the same time pressing on the bulbomembranous junction with the finger over it on the perineum, the angle will become a little less acute where the pendulous urethra joins the beginning of the fixed curved portion of the urethra, and the instrument will slip more easily into this curved portion.

The resistance which the straight instrument meets when passed as far as the bulbomembranous junction, if no stricture exists, may be owing to the contraction of the sphincter urethræ muscle. This is generally more pronounced in neurotic persons and in those on whom the catheter is passed for the first time, and is again referred to under spasmodic stricture. In passing a straight instrument, by elongating and depressing the penis, thereby putting the urethra on the stretch, and by making slight gentle perineal pressure, this obstruction, if present, is generally overcome. Care should be observed not to exert too much pressure, and that it may be directed properly.

In passing instruments, whether straight or curved, the portion of the urethral canal most likely to be injured is the floor of the urethra at the bulbomembranous junction.

It is a safe plan, in using either a straight or a curved instrument, to keep closely to the roof of the urethra until the instrument has entered the curved portion, pushing it forward with a slow and gliding movement; it should be borne in mind in every case, whether the instrument is passed by the operator or by the patient himself, that the object sought is to make the end of the catheter find the anterior opening of the fixed portion of the urethra. If the operator loses sight of this aim, he may fail to find the opening.

Ordinarily, when a catheter, either straight or curved, enters the bladder, this is evidenced by the relaxation of the contracted muscle or by the escape of a small quantity of urine from the end of the catheter. In thin subjects this fact may also be easily determined by placing the palm of the hand on the abdomen above the pubes, when the beak of the instrument can be felt

against the hand if a curved metal sound or catheter has been used. If doubt exists, three or four ounces of fluid may be injected through the catheter by means of a syringe. If the fluid runs into the bladder, ordinarily it will return through the catheter when the latter is depressed. If it does not run out again through the catheter on depressing the penis, it demonstrates that while the curved portion of the urethra may have been reached, the instrument has not as yet pushed far enough along the urethra to meet the bladder. If the fluid injected is not returned through the end of the catheter

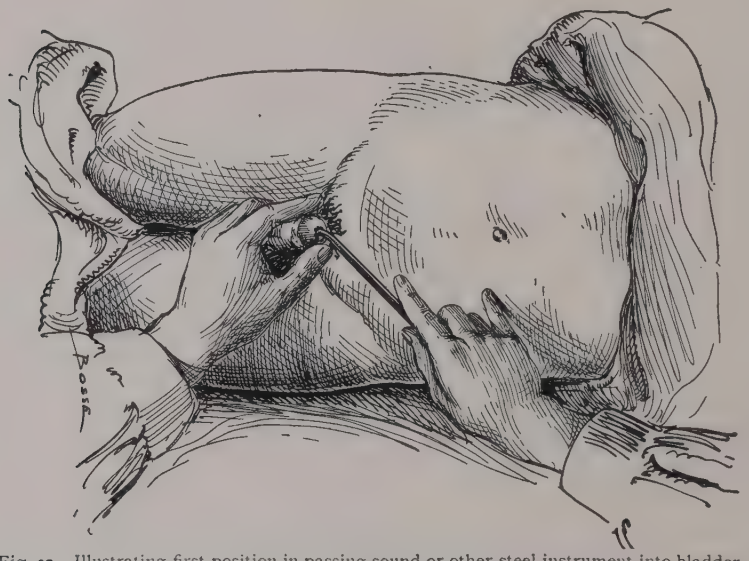


Fig. 20.—Illustrating first position in passing sound or other steel instrument into bladder.

when depressed and does not remain in the bladder, but runs out of the meatus along the side of the catheter, it is evidence that the curved portion of the urethra has not been passed, and that the compressor urethræ muscle has not yet relaxed.

In passing a curved instrument the operator stands at the side of the patient that is most convenient to him. The penis is grasped in the left hand, the instrument being held in the right. The organ is put well on the stretch, and held at an angle of about 45 degrees to the body. The operator should have in mind that, until the bulbomembranous junction is reached, the straight portion of the

curved instrument should be kept as nearly parallel with the body as possible. The instrument may, if it is more convenient, be introduced with the upper portion pointing toward the feet of the patient, being rotated down into the urethra until it is parallel with the groin, and then revolved again until its upper extremity is parallel with the abdomen, the upper portion being just below the umbilicus; or, in passing the instrument, it may first be introduced parallel to the groin, and then be brought around on a plane parallel to the abdomen. In either case this last should be the final position before the attempt is made to pass the instrument into the blad-

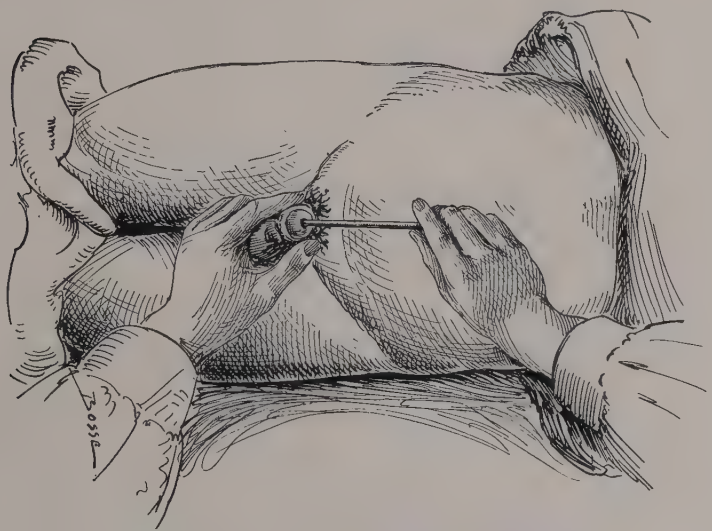


Fig. 21.—Illustrating second position in passing sound.

der. Figs. 20 and 21 illustrate these positions. During this procedure no forcible attempt should be made to push the instrument into the urethra; the urethra should, rather, be pulled up on the instrument, put and kept on the stretch by the fingers of the left hand, the thumb and forefinger of the right hand holding the instrument—not firmly, but as if they were balancing it. While the catheter is still so balanced its curve will disappear into the urethra for four or five inches, the urethra having, as previously directed, been brought well up on the instrument by the left hand. The shaft of the instrument should, as was mentioned before, be kept

parallel to the abdomen, the left hand keeping the urethra on the stretch. Then raise the urethra, containing the instrument, to a position at a right angle with the patient's body. Next, the penis, still kept on the stretch, should be brought down between the patient's legs until it points toward his feet. The thumb and forefinger of the right hand should, at the same time, balance the instrument, and, instead of pushing it, it should be allowed to progress downward by reason of its own weight. The operator should really feel with the beak of the instrument for the beginning of the opening of the fixed portion of the urethra; he should rarely use much force in pushing the instrument, and, above all, he should avoid pushing its beak into the floor of the urethra. At times slight spasm of the compressor urethræ muscle exists; this may often be overcome, after the instrument has been brought over so that its beak points toward the place where the opening of the fixed part of the canal should be, by keeping the handle well depressed between the legs with the left hand, and pressing down on the abdomen with the right.

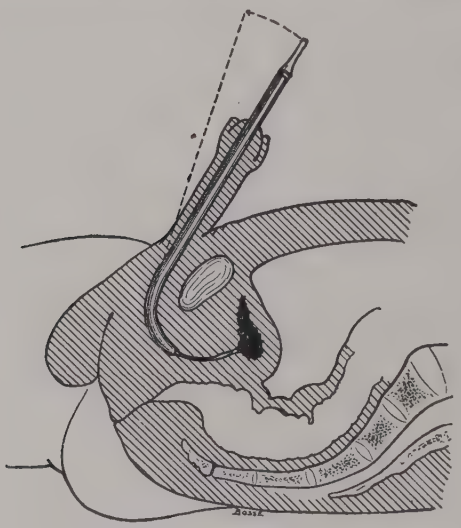


Fig. 22.—Illustrating third position in passing sound.

When the beak of the instrument has entered the curved portion of the urethra, the left hand, which has been holding the penis and keeping it on the stretch, should be removed, and the instrument grasped at its upper extremity between the thumb and forefinger of the left hand, and allowed to enter the bladder. It must be repeated that little, if any, downward pressure is to be made when the instrument is first moved. From lying with its shaft parallel to the abdomen it is brought up to an angle and made

to describe an arc, so that when it finally enters the bladder, its upper outer extremity is descending toward the toes of the patient. During this procedure it should constantly be borne in mind that an attempt is being made to pass a curved instrument into a curved canal, not a straight instrument through a straight canal. The operator must be careful and diligent in searching with the beak of the instrument for the opening in the fixed canal. In passing coudé catheters, cystoscopes, and dilators with very short curves the necessity for depressing the penis while on the stretch farther between the legs, in order to make the curved portion enter the curved portion of the canal, is greater than in the case of the ordinary instruments. In the presence of stricture, the

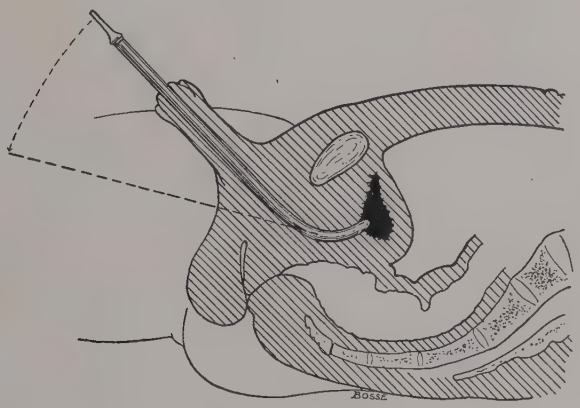


Fig. 23.—Illustrating fourth position in passing sound.

expert can be somewhat more heroic in his methods of pushing an instrument through the obstruction into the bladder than one with less experience. In such cases, however, it is a fairly safe rule to let the beak of the instrument hug the roof of the urethra closely.

There is a general impression that attempts at passing a soft-rubber catheter, whether made by patient or by surgeon, can result in no harm, even if the efforts to make it enter the bladder are futile. This view is an erroneous one, for the soft-rubber catheter is inclined to double up at the bulbomembranous junction, and, if force is exerted, may result in traumatism, which, although slight, may be sufficient to start up an infective process. If it is found impossible, either for the operator or the patient, to pass a

soft-rubber catheter, an attempt should be made to pass either a coudé catheter or one of the flexible olive-pointed French silk catheters.

Occasionally, any difficulty that may be experienced in passing a catheter or sound with the patient in the prone position may be overcome by having him assume the erect posture. This latter position may be preferable in two classes of patients—those in whom a spasm of the compressor urethræ muscle exists, and those in whom a pocket at the bulbomembranous junction occurs. Some patients, especially neurotics, are more successful in passing the sound or catheter themselves than is the attendant, and accomplish it with less distress.

In those individuals who have a pocket at the bulbomembranous junction, the instrument, when its handle is depressed, seems to engage in the pocket instead of entering the fixed portion of the curved urethra; if, while the handle is depressed, the instrument is pulled very gently slightly outward for about a quarter of an inch, so that the beak is pulled up a little more on the roof of the urethra, and the handle is again depressed, the beak will not infrequently find its way into the curved canal. Pressure with the fingers of the left hand on the perineum over the beak of the instrument aids in such conditions. These are often found in old men in whom the urethra exhibits a tendency to sag down at the bulb.

For descriptive purposes, the methods of passing the catheter or sound may be divided into three stages: To recapitulate, in the first stage the instrument is introduced as far as the bulbomembranous junction and is placed with its shaft parallel to the abdomen and its upper extremity below the umbilicus; in the second stage it is brought over in a curve, so that its upper extremity points toward the feet of the patient; the third stage represents its progress through the prostatic urethra into the bladder. When the instrument has been brought into such position that its shaft is parallel with the abdomen, care should be taken to see that, by stretching the penis, the urethra is well pulled up on the instrument. This is particularly necessary with those inclined to corpulency.

Time and gentleness are the two important factors in passing

BOSTON MEDICAL
FEB 14 1918
LIBRARY

an instrument through the urethra, either for purposes of examination or to empty the bladder. Patients who are obliged to catheterize themselves will, after a time, generally find the catheter that is best adapted to their needs. We have previously stated that, in these cases, the soft-rubber catheter, of as small a caliber as seems practicable, or the silk coudé catheter, will be found most suitable. The English silk catheters with stylets, so popular in the past, have proved dangerous in both the patient's and the practitioner's hands, and have fallen into disuse. They possess all the disadvantages of the steel instrument, and, besides, being made of silk, are likely to be handled carelessly.

THE VALUE OF THE X-RAY IN DIAGNOSIS

Since the previous edition of this work was published such rapid advances have been made in the diagnostic ability to diagnose diseased conditions of the urinary tract through the use of the *x*-ray that it has been thought best to rewrite the article published at that time. It is difficult in a work of this nature and scope to always allow the proper amount of space for each given subject. It is our desire to give the views resulting from our personal experience as clearly as possible, and to refer inquirers desiring to study the subject comprehensively to the vast amount of literature which has accumulated during the past three years on this matter. It should be noted here that the personal experience of men very familiar with this class of work who conduct the *x*-ray laboratories in the clinics and hospitals of large size is often of great value not only in giving them ability to take a photograph of the various lesions, but also to translate the same for the benefit of the individual not very familiar with such work. Concerning the bladder, it can be stated that an *x*-ray plate, skilfully taken, will demonstrate in the vast majority of cases very distinctly such a condition as stone in the bladder.

Stone in the ureter can generally be clearly demonstrated, although confusion may sometimes occur from the presence of shadows there, most often due to cicatricial conditions occurring either in the ureter or adjacent to it. It is rarely that stones in the kidney cannot also be clearly demonstrated through the same procedure. Efforts are occasionally made to diagnose such condi-

tions in the bladder as diverticula of that organ through the aid of an injection of a solution of bismuth. Success in our limited experience with this procedure does not often occur, but it is probable that as we become more familiar with the technic this will more often furnish an aid for the discovery of such conditions. The solutions of bismuth are apparently unirritating to the bladder, although it is difficult to entirely wash away the bismuth immediately from the bladder surfaces, and it may be several days before the bismuth placed in the bladder is entirely eliminated. Ureter catheters coated with bismuth, which have for a long time been obtainable for this work, are of material aid in connection with the use of the *x*-ray in diagnosing conditions of the ureter and to some extent of the kidney, particularly as regards the position of this latter organ. When a solution of some metallic substance is injected or poured through such a catheter, either into the ureter or beyond it into the kidney, pelvis, and colices, a procedure to which the term "pyelography" is applied, valuable information may not infrequently be obtained. At the present time it is wiser to hold views of a conservative nature, both as regards the information to be obtained from this procedure and the inconveniences or dangers attending it. At the same time, as we look back and see how much has been gained in the line of diagnostic procedure from the use of the cystoscope and ureter catheterization, it would seem as if in a short time very brilliant results should be obtained through pyelography. Just at present the number of men who have obtained them are few. An excellent book on the subject is that of W. T. Braasch ("Pyelography," W. B. Saunders Co., 1915).

The substances generally used are solution of thorium, collargol, and argyrol. Their value is probably in the order mentioned. The solution of thorium (a 10 per cent. one being used) is prepared as follows:

To make 100 c.c. of a 10 per cent. solution 10 gm. of thorium nitrate are dissolved in as little distilled water as possible; to this solution, kept hot on a water- or steam-bath, are added 30 c.c. of a 50 per cent. solution of sodium citrate, the additions being made in small quantities and care being taken to shake the solution thoroughly after each addition. At first after the addition of the citrate solution a white gummy precipitate is formed, which later becomes

granular, and finally dissolves on the addition of all the citrate solution. This solution is then made neutral to litmus by the careful addition of a normal solution of sodium hydroxid, and made up to the required volume of 100 c.c. with distilled water. On filtration, a clear, limpid solution is obtained, which, when sterilized, either by boiling or steam under pressure, is ready for use. The stability of the solution is not affected in the least by sterilization.

We have endeavored to illustrate (fig. 24) in a single line, so that the eye can see at a glance, a schematic view of about what is sup-

Fig. 24.—1, 2, and 3, Normal kidney, pelvis, and calices; 4, 5, and 7, hydronephrotic kidney; 6, inflammatory dilatation due to stone; 8, kidney with double pelvis.

posed to be the various conditions found in the kidney after the injection of one of these salts, and the picture is taken. This schematic drawing which we present is not taken directly from plates either of our own or of other observers, but only represents the equivalent of what might be considered a composite photograph.

The injections are made with the patient in a prone position, with a solution so liquid that it will easily pass through the ureter catheter which should not be too large to easily pass through the ureter.

It seems to us that it makes little difference whether the gravity method of pouring it in through a funnel at as low a height as will permit the fluid to flow is adopted or whether it is injected very slowly and carefully. Two to 5 c.c. of the solution are generally sufficient, although a hydronephrotic kidney will sometimes hold much more. At the first evidence of colic, injections should cease. After the injection is made, exposure to the plate should be as short as practical, and an effort should be made to remove all the solution remaining in the kidney. In a general way those who are very familiar with this work claim that a normal kidney pelvis and calices can be demonstrated, that the distention due to a hypernephrotic sac can be determined, and that various inflammatory conditions which are more liable to attack the calices can be made out. If a stone is suspected, it is wiser to take a picture to try to determine it before pyelography is attempted. It is also useful in showing kinks of the ureter, strictures of the same, and malpositions of the kidney. The inconveniences and dangers attending this procedure are as follows:

While the schematic drawing (see fig. 24) in a general way is supposed to outline some of the conditions that may be found to be present, a proper interpretation of a plate may often only correctly be made by a man well versed in that work. Concerning the dangers, the chief one seems to be the overdistention of the pelvis of the kidney and the forcing of the solution or some of it into the parenchyma of the organ, giving rise to inflammatory disturbances, possibly an embolus. A very interesting and scientific article has been written on this subject by M. Mason, M. D., "Dangers Attending Injections of the Kidney Pelvis for Pyelography," Jour. Amer. Med. Assoc., 1914.

It is the opinion of some men who have done considerable work in this line that pyelography should only be attempted after the observer has been unable to make a proper diagnosis of existing conditions through other measures, such as the use of the cystoscope, ordinary *x*-ray plates, tests for the permeability of the kidney, and similar procedures. While such a view may be correct in many cases, it should be still borne in mind that where operation seems inevitable, even if of an exploratory nature, as a rule no great harm

exists, and possibly some valuable information may be obtained through this measure.

Great care in mild or suspected cases of tuberculosis of the kidney should be exercised in attempting to inject any of the above-mentioned substances into the kidney pelvis, as by so doing a condition necessitating an operation may be brought on which might otherwise have been avoided.

CHAPTER II

ENDOSCOPY.—CYSTOSCOPY.—CATHETERIZATION OF THE URETERS

ENDOSCOPY

With the invention, within recent years, of a small electric light that does not give off heat and that can be placed at the end of a tube introduced into the urethra, this method of making urethral examinations has come largely into favor. The tubes used for making endoscopic or urethroscopic examinations are procurable in a variety of lengths, and the various manufacturers have projected numerous modifications of the original. The principle of most of them, however, is the same. The endoscope in general use is a metal tube fitted with a mandarin for introduction; the tube being inserted into the urethra to the desired point, the mandarin is removed, and a tiny electric light is introduced on its groove to the distal extremity of the tube.

In order properly to examine the urethra by means of the endoscope the patient should lie on a high table, in a semirecumbent position, his legs, from the knees down, hanging below the table, and rest on two supports or chairs. The examiner should sit on a stool at his feet. The bladder should be emptied previous to examination, and about one dram of a 2 per cent. cocain solution be injected into the deep urethra. If the size of the meatus will admit, the endoscopic tube is easily passed as far as the bulbomembranous junction. If, when a more extensive examination is demanded, it is desired to introduce the tube beyond the bulbomembranous junction, it is necessary to depress the outer end of the endoscope to a very marked degree. This is best done in all cases, especially when the instrument is used for diagnostic purposes, for it is only by allowing the end of the tube to pass a little beyond the bulbomembranous junction that the colliculus can well be made out and a fair conception be had of the appearance

of the deep urethra. For these purposes, and more especially for that first mentioned, a tube somewhat smaller than that required for examining the pendulous urethra alone should be selected. Curved endoscopic tubes, though easier to introduce into the posterior urethra, have not, as a rule, been found to be of much practical value. A straight tube, by being well depressed, can be introduced with comparative ease so far into the posterior urethra that the colliculus, especially if enlarged, can be seen at the distal end of the tube. When this is seen, the tube is slowly withdrawn, and various portions of the urethra from the colliculus out can be examined as the tube is removed. Pledgets of cotton wound on the end of long slender applicators should be frequently

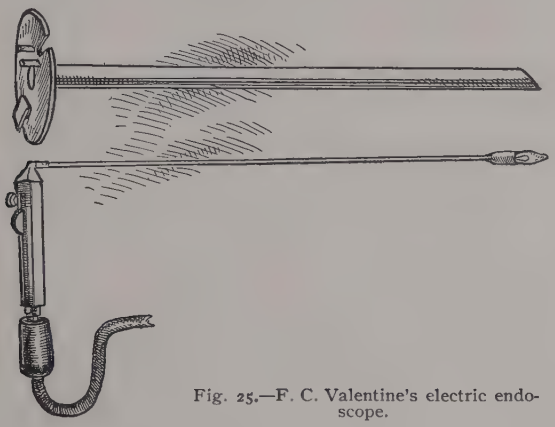


Fig. 25.—F. C. Valentine's electric endoscope.

introduced through the tube in order to remove the constantly accumulating mucus, which would otherwise obstruct the view. It is only after considerable practice in the examination of healthy urethras by the endoscopic method that one becomes thoroughly familiar with the normal urethral picture. An endoscopic examination will reveal to the surgeon the conditions that exist from the colliculus outward, and it should always be made in those cases in which the ordinary treatment for chronic inflammatory conditions of the urethra fails to give good results. The presence of vegetations or of internal chancre may be ascertained through an endoscopic examination. The effect of treatment may, if desired, likewise occasionally be observed. A persistent localized lesion also may be treated by means of the endoscope

in a satisfactory manner. This is particularly true of those cases in which infection of the follicles exists, pus being easily seen exuding from them. For the treatment of such conditions as infected follicles, a fine-pointed galvanocautery probe can be introduced through the endoscope in a line vertical to the base of the follicle, which is then destroyed by means of the current. Not more than two or three follicles should be destroyed at one sitting, and the operation should not be repeated oftener than once

Fig. 26.—Galvanocautery point.

a week. Small knives devised for the purpose may be used to open up infected glands and for other purposes, such as the removal of vegetations.

Applications made through the endoscope seem to be of practical use in reducing hypertrophy of the colliculus. This hypertrophy is frequently accompanied by loss of sexual vigor. Once seen through the endoscope, the colliculus is easily recognized

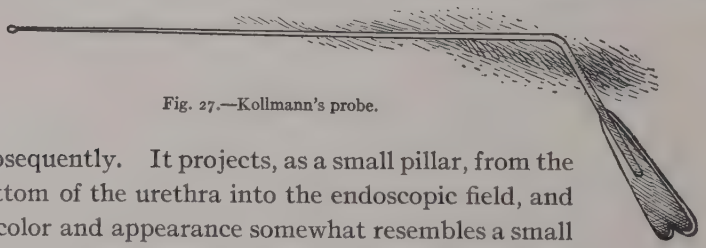


Fig. 27.—Kollmann's probe.

subsequently. It projects, as a small pillar, from the bottom of the urethra into the endoscopic field, and in color and appearance somewhat resembles a small preserved mushroom. When hypertrophied, the mound appears much higher. This hypertrophy may be reduced and the sexual tone restored by applying a strong solution of silver nitrate (from 30 to 60 grains to the ounce) for a moment on a pledget of cotton to the colliculus. This method of treatment has also been recommended by some German writers as an excellent one for the relief of neurasthenia of urethral origin.

Most of the endoscopes for sale in this country have a tube that is cut off straight at its lower end. A much better field for observation is obtained through an endoscope having the tube

PLATE I

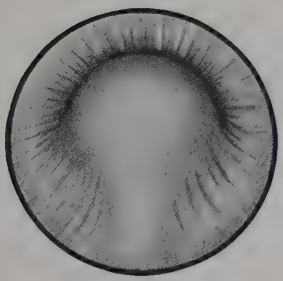


Fig. 1.

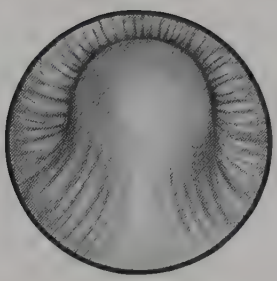


Fig. 2.

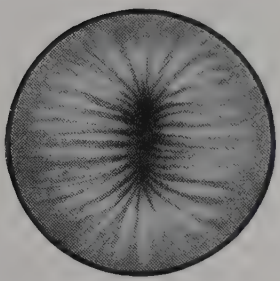


Fig. 3.

Fig. 4.

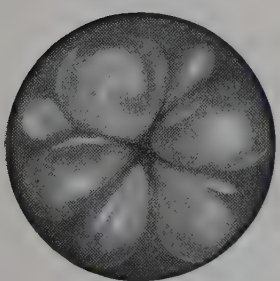


Fig. 5.

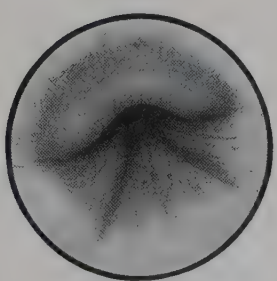


Fig. 6.

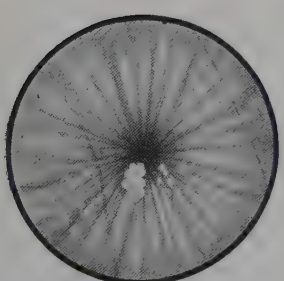


Fig. 7.

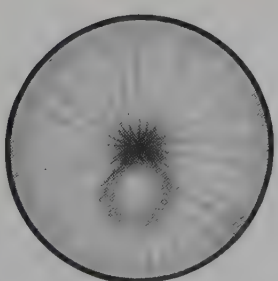


Fig. 8.

cut off at an angle at its lower end, as shown in the illustration. Several years ago Dr. W. K. Otis, of New York, devised an endoscope having the light at its outer end, the light being reflected into the tube. Recently he devised another, based on the same principle as the first, but by which a much better illumination is afforded. The advantage of having the light at the outer orifice is that the light and its carrier do not infringe on the lumen of the tube, and thus applications are more easily made through it.

It can easily be seen how valuable, under certain conditions, treatment through the endoscope may be. At the same time it is well to remember that most of the obstinate or serious inflammatory urethral conditions are situated in the deep urethra, and although such conditions as infected follicles in the pendulous urethra may be treated individually, any existing inflammatory condition situated further along the urethral tract must not be neglected. In other words, no good results will follow the treatment of the minor lesions if the more serious ones are overlooked. George Luys has written a very interesting book on the practical use of the endoscope.[1]

There are certain things that should be remembered by those who attempt practical work with the endoscope. The two things to be especially noticed in the endoscopic picture are the central figure and the mucous surface. The central figure or window varies according to the location of the endoscope in the urethra. In the glans the central figure is a little oval, perpendicular at the pendulous portion, like a point at the bulb, like a vertical window at the verumontanum, crescent-shaped in the prostatic urethra. The mucous surface varies in its appearance normally, as regards its folds and striations, according to the size of tube used and the pressure. It and the shape of the central figure as well are changed by disease. As an illustration, in soft infiltration the longitudinal folds are changed, diminished in number, and the striations lost in the tumefactions, while the central figure is shortened. This condition is most apt to be found in what may be termed beginning chronic urethritis.

In hard infiltration as may be supposed, the color is paler, the striations may have disappeared, the window opening gives more

[1] "Endoscopie de l'urètre et de la vessie," Paris, 1904.

the appearance of an opening into a funnel, and the whole condition of the urethral wall has become inelastic. This condition of hard infiltration is what is met with in true stricture, and is due to the formation of connective-tissue fibers. The glands of Littrè and the lacunæ of Morgagni are apt to become cystic through the effect of this connective-tissue formation; their mouths may be open and swollen, surrounded by inflammatory zones, or closed by the fibrous tissue, and the cyst thereby become subepithelial. These two conditions of hard and soft infiltration naturally merge the one into the other and are not generally seen as two distinct entities.

A field of vision of different form is obtained by the use of the urethroscope, in which the urethra is distended either by means of air or of water. Of the former type, an instrument has been devised by Dr. G. Greenberg and manufactured by Kny-Scherer Co., of New York. Of the latter type, in which the urethra is distended by water, the Goldsmith "irrigation urethrocystoscope" may be found useful. The use of this instrument in the hands of one of our assistants has given good results. The field exposed is that of a flat wall instead of a small circular field as exhibited by the ordinary instrument.

A practical way to thoroughly examine the urethra when such an examination is required is to use this latter instrument first, but any diagnosis arrived at should be confirmed through the use of a plain tube later.

CYSTOSCOPY

The illumination and inspection of the human bladder by means of the cystoscope furnish a means of diagnosing diseases of that viscus. The history of cystoscopy dates back to 1807, when

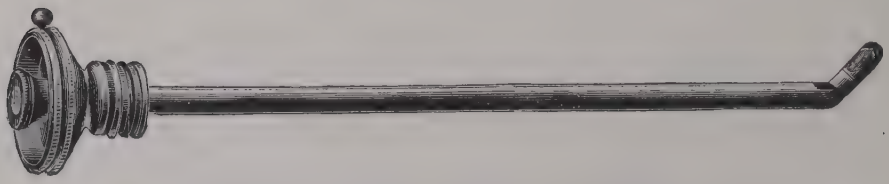


Fig. 28.—Nitze's cystoscope for observation of bladder.

a German physician, Dr. Bozzini, published an article on "The Light Contractor, or a Description of a Simple Contrivance for

Illuminating the Internal Cavities of the Human Body." His instrument, as illustrated in the article just named, consisted chiefly of the chamber that contained the light, and of various light conductors, shaped for use in different organs. His object was to throw the light through the conductor into the various cavities, and reflect from its wall into the observer's eye. The instrument did not receive general recognition, but it certainly marked the beginning of the many well-developed cystoscopic methods of the present day. Next along this line of invention came the "Speculum Urethro-cysticum," devised by Dr. Sagalas, and presented to the French Academy of Medicine in 1826. In 1853 Dr. Desormaux brought his endoscope, a modification of the foregoing instrument, to the attention of the Academie de Médecine of Paris. Later Dr. Bruck, a German dentist, examined the bladder by means of a tube introduced into it through the urethra, and a strong, white-hot platinum wire in the rectum, controlling the heat produced by this wire by means of a continuous circulation of cold water around it. Through this tube he was able to inspect the highly illuminated interior of the bladder.

The first actual cystoscope, however, was that evolved by the late Dr. Max Nitze, aided by Joseph Leiter, a well-known instrument-maker of Vienna. Dr. Nitze presented his instrument to the Society of Physicians in Vienna in 1879; he later added improvements to it, the outcome being the irrigating cystoscope and the various catheterizing and operating instruments that are in use at the present day. All his are prism or indirect cystoscopes.

Since the introduction of Dr. Nitze's instrument, many modifications of it have been devised by operators in various parts of the world. Chief among them are the straight cystoscope and the air cystoscope. These are constructed on the same principle as the Nitze instrument, but each has some peculiar advantage of its own.

An examining cystoscope, to be a good one, should fulfil several requirements. It should present as large a visual field as possible. It should be of a caliber not too large to pass easily through the urethra, and it should, if possible, be of such shape as to permit practically the entire bladder-wall to be examined. A

complete examination of the bladder cannot be made by any examining cystoscope which is at present on the market. Of any single instrument, the most satisfactory one for purposes of examination of the bladder in the hands of the writers is the original Nitze examining cystoscope. Unfortunately, there are certain portions of the bladder wall which cannot be examined by any instrument with a prismatic lens, such as is used in the Nitze instrument. Parts of the anterior bladder wall, part of its posterior wall, and part of the neck of the bladder cannot be carefully inspected through this instrument. Therefore, in order to make the examination of the bladder wall absolutely complete, it is necessary for the examiner to have a series of instruments by which all the posterior wall can be seen, and for this purpose a straight view instrument is indicated; and

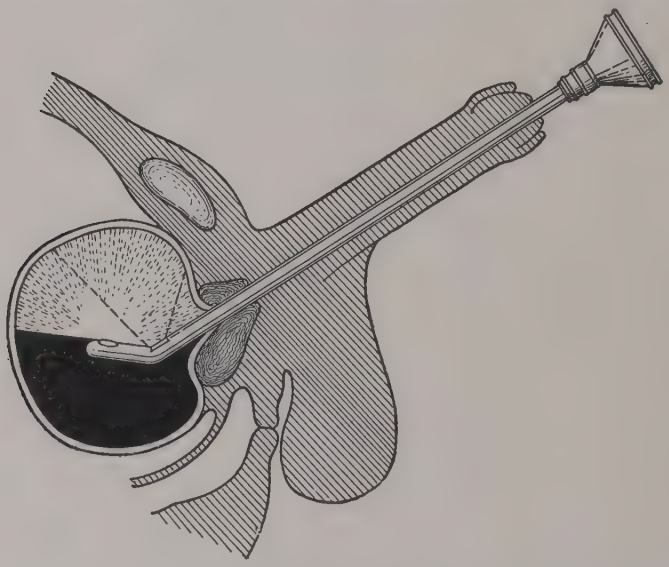


Fig. 29.—Showing field in Nitze's exploring cystoscope (Berger and Hartmann).

to entirely examine the anterior wall of the bladder and the neck of the bladder, particularly any pouch which may underly an enlarged prostate, an instrument giving a retrospective view is necessary. Dr. Schlaginweit, a pupil of Nitze's, designed the original retrospective instrument, which is for sale and used to some extent in this country. It can be seen, therefore, that

it is necessary to have three different instruments in order to be absolutely sure that every portion of the bladder wall has been examined. Though a fair general idea of the bladder can be obtained from the examining Nitze, and an idea as to whether or not an enlarged prostate exists, a complete examination is necessary when there is a question as to whether or not any tumors may be present, as there frequently is around the neck of the bladder, or such a condition as stone lying underneath an enlarged prostate, which not infrequently happens, other instrument or instruments will be required.

To obviate the trouble and expense connected with having a number of separate instruments made by different manufacturers several so-called "universal" cystoscopes have been devised in which, through the introduction of various shaped lenses and mirrors, through the same sheath, the entire interior of the bladder may be viewed. These instruments resemble one another to a very great extent, and the difference between them consists mainly in slight changes in regard to curve, various modifications of the prisms and of the mechanism. The Wappler Mfg. Co. have recently made one of this type at the suggestion of my associate, Dr. S. W. Schapira, which has been used by one of us, and is apparently useful in fulfilling the various indications outlined above. Through a common sheath can be introduced a lens for the indirect examination, for the direct examination, for catheterization of the ureters by the ether method, and for the retrospective, as well as one containing a stone crusher associated with the lens, and one through which minor operative procedures may be carried on under observation. A rubber bulb attachment permits of the bladders being inflated with air instead of a fluid; this is sometimes of use when such a condition as tuberculosis of the bladder is present.

Practical Cystoscopy

Position of Patient.—For examination of the bladder, the patient may be placed flat on the back in the lithotomy position, the illustrations below (p. 65) showing the proper supports and correct angle of legs to body.

The genitals are then cleansed, and a sterilized catheter is in-

serted into the bladder. The contents of the bladder are evacuated, and if the urine is not clear, the bladder is washed repeatedly until the fluid comes away clear; the viscus is then filled with a 2 per cent. boric-acid solution and the catheter withdrawn.

The proper instrument having been chosen, the light of the cystoscope is adjusted, and the instrument intended for inspection is well lubricated and inserted into the bladder; the light is turned on, and if the prism instrument is used, through rotation the anterior wall of the bladder, the roof, the floor, and the sides of the bladder are examined as thoroughly as the shape of the instrument will permit. Bearing in mind what has been said about the limitations of view through the various shaped cystoscopes, if it seems required on its withdrawal, a cysto-

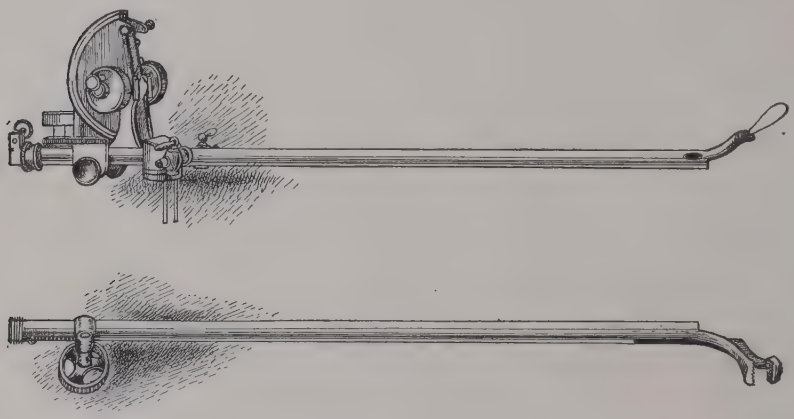


Fig. 30.—The Nitze operating cystoscope.

scope of another shape should then be introduced in order to make the examination as thorough as possible. By practice through the use of the artificial so-called phantom bladders, at present being sold by the surgical instrument houses, some familiarity with the use of the cystoscope can be obtained by the beginner, and they will be found useful for that purpose to a considerable degree. In examining the bladder the importance of method need hardly be insisted upon in order that no part of the mucous membrane may unnecessarily be overlooked.

Very interesting are the views obtained of the neck of the

bladder through the retrospective lens. When the retrospective cystoscope is pushed toward the neck of the bladder, the urethra, looking through, it appears as a slit. As the cystoscope is pulled

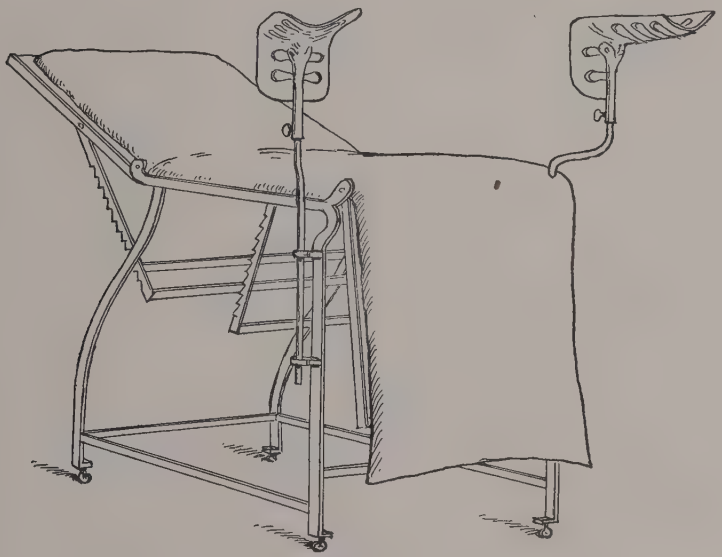


Fig. 31.—Table showing Bierhoff supports for legs in cystoscopy.

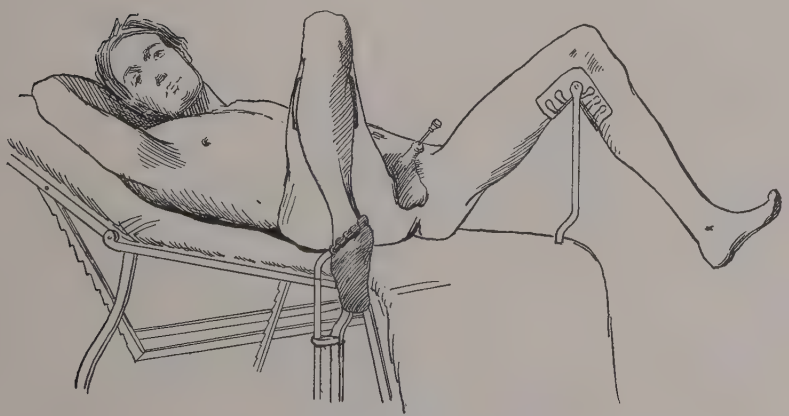


Fig. 32.—Position for cystoscopy.

forward and the retrospective appliance is brought nearer to the neck of the bladder, the urethral orifice appears enlarged, and

the cystoscopic tube itself can be seen, as shown in our illustration.

Cystoscopic Appearances.—*Acute Cystitis.*—The picture varies according to the degree of inflammation present. A general hyperemic condition is noticed, most marked at neck of bladder with dilated blood-vessels.

Chronic Cystitis.—The mucous membrane may be pale or dark gray, and the bladder folds so thickened that if the thickened condition is localized, it may at times be differentiated with difficulty from a tumor.

Non-tubercular Ulcerative Cystitis.—This may be due to the ingestion of certain drugs or to repeated attacks of cystitis, and occurs most often in women. It is present only in rare grave forms of vesical disease. The bladder is always very irritable, and will rarely hold more than one ounce of fluid. One or more characteristic ulcers may be seen on an otherwise perfectly healthy mucous membrane.

Tubercular Cystitis.—In this condition the cystoscope reveals localized hyperemic spots of vesical mucous membrane, with distinct tubercles.

There may also be distinct tubercular ulcerations, the edges of which are somewhat elevated, in contradistinction to those of the ordinary cystic ulcer.

Syphilis of the Bladder.—It has been known for several years that syphilis occasionally attacks the walls of the bladder. In earlier editions of this work it was stated that we had noticed that contracted bladder with chronic cystitis was not infrequently associated with a syphilitic history, and that proper antisyphilitic constitutional treatment was a great aid to the local measures instituted.

Two procedures developed within the past few years have been very valuable diagnostic aids for the recognition of these lesions—the more common use of the cystoscope and the Wassermann reaction.

Syphilis is most often found attacking the bladder in the later rather than the earlier manifestations of the disease. Syphilitic lesions may be mistaken either for tuberculosis or for papilloma of the bladder. They usually consist of deep or shallow ulcerations,

PLATE II

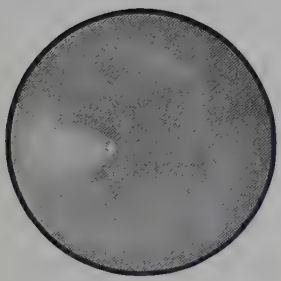


Fig. 1.

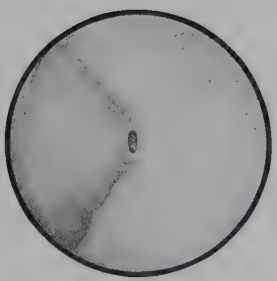


Fig. 2.

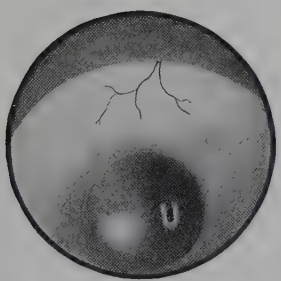


Fig. 3.

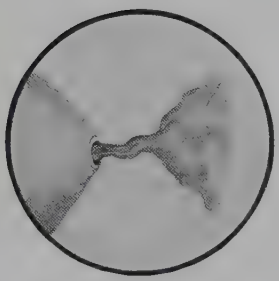


Fig. 4.

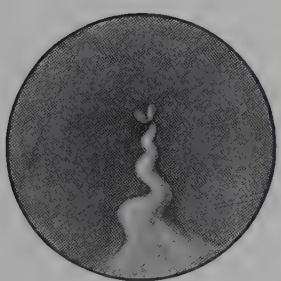


Fig. 5.

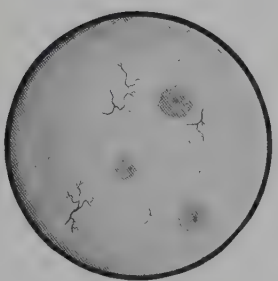


Fig. 6.

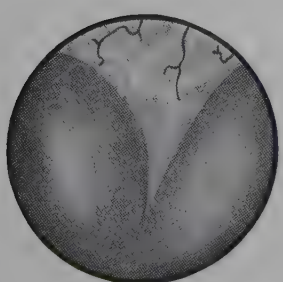


Fig. 7.

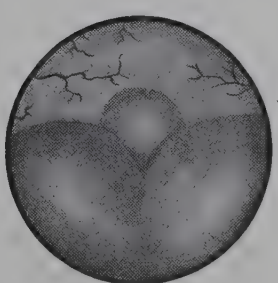


Fig. 8.

PLATE III

Fig. 9.—Encysted multiple stones —four only are shown.

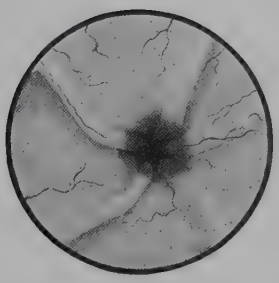


Fig. 10.—Trabecular bladder; diverticulum of lateral wall.

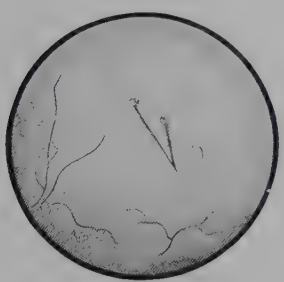


Fig. 11.—Pin fixed in the anterior wall of the bladder near its vertex; shadow on the opposite wall.

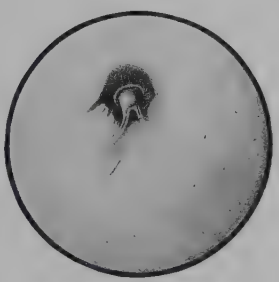


Fig. 12.—Silk ligature adherent to the wall of the bladder, near its vertex; shadow on the opposite wall

Fig. 13.—Two fragments of stone which remained in the bladder after lithotrity; in the larger one the nucleus of uric acid is seen.

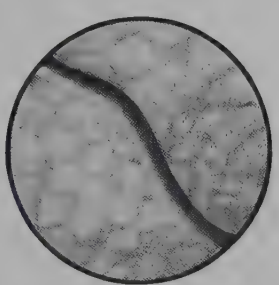


Fig. 14.—Catheter covered by urine concretions.

PLATE IV

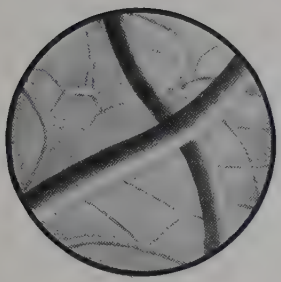


Fig. 15.—Catheter doubled upon itself.

Fig. 16.—Cauliflower tumor of bladder.

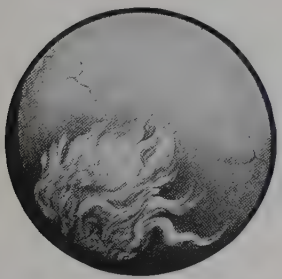


Fig. 17.—Villous epithelioma.

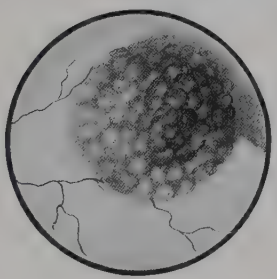


Fig. 18.—Cancerous sessile tumor of the bladder

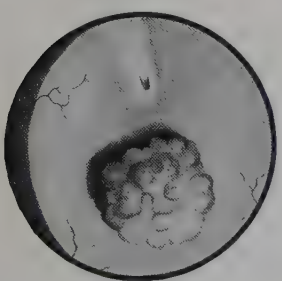


Fig. 19.—Lobulated epithelioma.

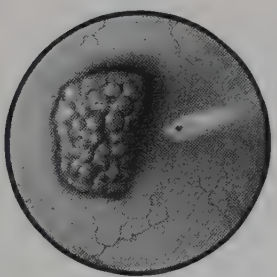


Fig. 20.—Tumor of bladder.

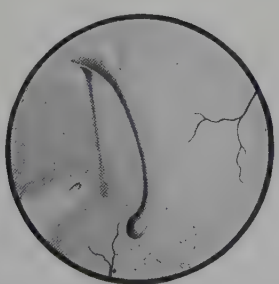


Fig. 21.—Small smooth tumor with long pedicle.

CYSTOSCOPIC APPEARANCES

single or numerous, but gumma may often give rise to tumor formations which are not infrequently pediculated.

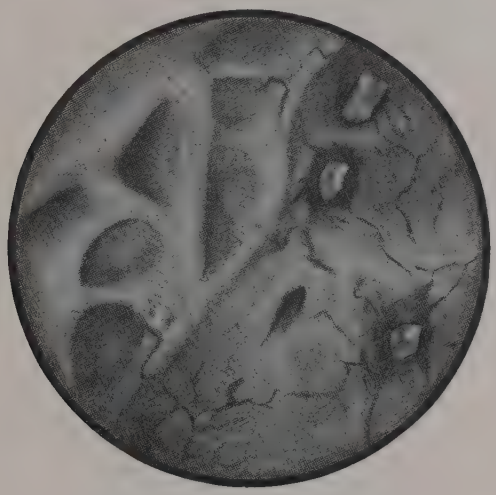


Fig. 33.—Syphilitic ulceration of the bladder.

An exhaustive and scientific article on this condition has been written by G. Gayet et E. Favre (Journal d'Urologie, July, 1914).

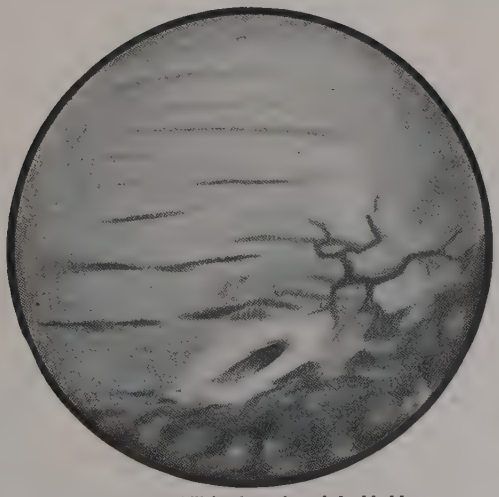


Fig. 34.—Syphilitic ulceration of the bladder.

Now that syphilis of the bladder is being diagnosed with increasing frequency its importance is becoming manifest in two different

directions. One is that when diagnosed it may often direct the proper treatment of conditions such as myelitis, locomotor ataxia, and generally the late lesions of the nervous system associated with syphilis. The indication is, of course, for active antisyphilitic together with such appropriate local treatment as irrigations or astringent applications as may suggest themselves to the surgeon.

Because gummata of the bladder have a tendency to take on tumor-like formations, it is important that a very careful inquiry should be made into the history and serology of all individuals with tumor of the bladder, and in questionable cases the therapeutic test thould be instituted in addition.

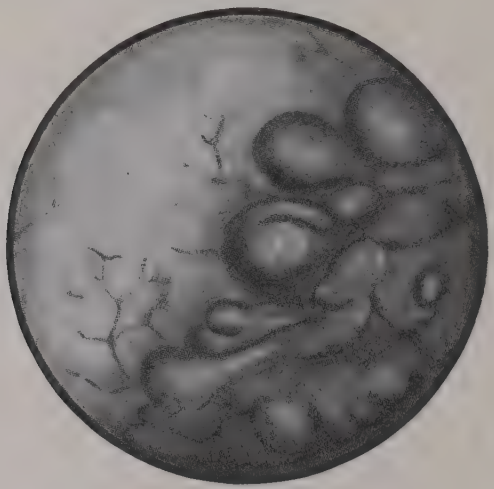


Fig. 35.—Syphilitic gumma of the bladder.

Foreign Bodies in the Bladder.—Foreign substances that cannot be detected by the sound, even in the hands of an experienced surgeon, may be easily seen and localized by means of the cystoscope.

Stone in the Bladder.—The cystoscope plainly reveals stones in the bladder, the observer being thus able to determine their size, shape, and mobility, and to percuss them with the beak of the cystoscope, guided by his eye.

Tumors in the Bladder.—It is in tumors of the bladder that the cystoscope finds its greatest field of usefulness, the presence of such growths being generally clearly detectable by its use, the

isolated tumors being more distinct than those made up of diffuse vegetations.

Enlargement of the Prostate.—Enlargement of the prostate can be diagnosed through the use of the cystoscope in some cases where it is extremely difficult to make a correct diagnosis of its existence through the other methods at the examiner's disposal. This is particularly true of those cases in which the principal part of the enlargement juts forward into the bladder and the rectal examination is of little aid. The folds of the trigone which come into view on the reversal of the prism instrument in the normal prostate show no inequality, while in enlargement of the prostate the folds give a shadow showing an unsymmetric enlargement, or an enlargement in the depression between the folds showing the presence of the third lobe. The study of the picture showing normal prostatic appearance, together with that of Figs. 7 and 8 of the cystoscopic plate (Plate II), will make the writers' meaning clearer.

Ordinarily, the exploring cystoscope should not remain in the bladder for more than fifteen minutes without the light being turned off; care should also be taken to see that the lamps do not become too hot, that the amount of fluid is not too slight, and that the cystoscope is not pulled too far forward lest the neck of the bladder be injured.

It may be well here to repeat the statement made in describing the use of the endoscope, namely, that, like this latter instrument, the exploring cystoscope may lend great aid in making a diagnosis, but before he attempts to diagnose diseased conditions by its aid, the examiner should, if possible, familiarize himself with the appearance of the normal bladder.

Cystoscopic diagnosis is not always easily made, much patience and considerable experience being necessary to avoid error. By its means a typical growth or a glistening stone is readily recognized, but the inexperienced cystoscopist will frequently be misled and perplexed by the appearance which the mucous membrane is wont to assume under the varying conditions of infiltration, relaxation, extravasation, and congestion. He may often, under the mistaken belief that he is dealing with a new-growth, be tempted to interfere operatively, to his patient's detriment.

INSTRUMENTAL EXAMINATION OF THE KIDNEY

Within the past few years much reliable scientific work has been done to show the condition of each kidney, by collecting the secretion of each of these organs separately. Many new tests, such as the phloridzin and the methylene-blue, have been exploited to show the permeability of the kidney, and much has been done, particularly abroad, to show the normal amount of the urinary constituents by such methods as cryoscopy. These methods, together with the examination of the blood, and particularly of the blood chemistry, have greatly increased our facilities for estimating more accurately the total amount of work done by each or by both kidneys. Of late it has become more and more the custom to decry the aid furnished by the presence or absence of albumin or casts in diagnosing disease of the kidney. The writers believe that their presence or absence is often of small diagnostic value, and attaches more importance in many cases to the test for kidney permeability and to the information derived from ureter catheterization as showing the condition of these organs. The methods that will be considered in detail here are those that practical experience has proved to be of value—that can be commended from personal observation; those measures that have been found to be impracticable or unsuitable for general work will not be exhaustively considered.

Catheterization of the Ureters

By persistent efforts during the past ten years, and more particularly during the past three, a few men, to whom great

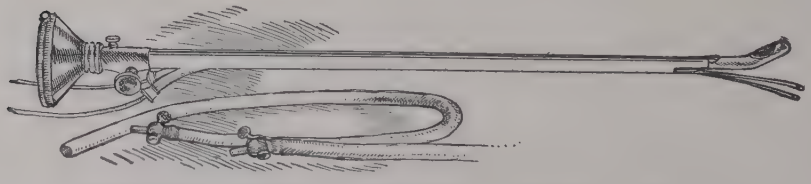


Fig. 36.—Bierhoff's cystoscope for the simultaneous catheterization of both ureters.

credit is due, have given the practice of catheterizing the ureters by means of ureteral catheter cystoscopes so great a stimulus that

the operation is now performed successfully in a large number of cases. Undoubtedly the modifications and variety of forms of

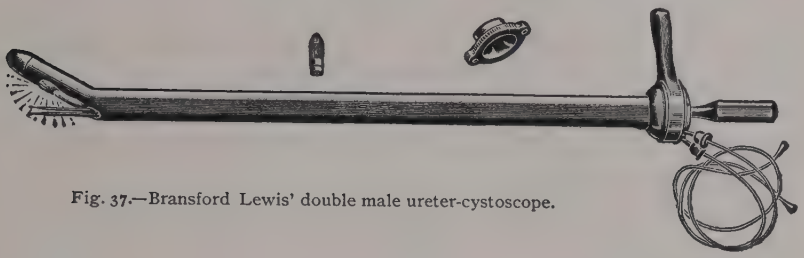


Fig. 37.—Bransford Lewis' double male ureter-cystoscope.

the instrument have played a part in the increased facility with which ureteral catheterization can now be performed—the improvements in lights, in lenses, and, above all, in its skilful application have helped considerably to make it a success.

Roughly speaking, catheterizing ureter-cystoscopes are of two types—the straight, of which the Brenner cystoscope is a type, and the concave or reverse type, represented by the Nitze or Albarran cystoscope. For the purpose of ureteral catheterization we personally prefer the straight type, and recommend the instrument made by the Wappler Manufacturing Co., of New York, called the F. Tilden Brown modification of the Brenner cystoscope. Of the concave or reverse type, the cystoscope made by the Kny-Scheerer Co., and called the Bierhoff modification of the Nitze-Albarran cystoscope, is to be recommended.

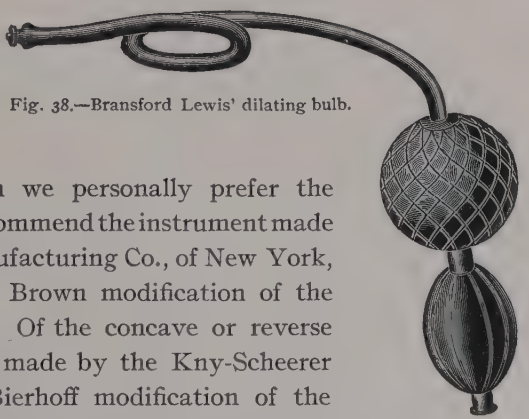


Fig. 38.—Bransford Lewis' dilating bulb.

There are many other similar instruments on the markets, in both this country and Europe, that may excel in some one particular or be superior to those just mentioned, but the writers are unfamiliar with them, and believe that each of the two recommended is a good representative of its class, or the possessor of a Universal cystoscope of the type previously mentioned can, through a common sheath, use the lens most suitable for the particular bladder, the ureters of

which are to be catheterized. As has been stated, for the mere purpose of locating the ureters and catheterizing them, the straight type of cystoscope is to be preferred; but it would be very difficult to examine the roof and the anterior walls of the bladder with a straight instrument if the bladder were distended. It has also been found, by practical experience, rather difficult to find the mouth of the ureter with a straight instrument when, as occasionally happens, the orifice is situated high up along the bladder-wall instead of in its usual place along the border of the trigone; while with the reverse type it is impossible to examine the posterior wall of the bladder.

Many of the ureteral catheter cystoscopes that are manufactured at the present time are recommended for use as ordinary cystoscopes for examination of the bladder-walls, as well as for catheterizing the ureters. For this purpose the concave is ordinarily preferable to the straight type, since through it the roof and the walls of the bladder, with the exception of the posterior one, may more easily be seen. The general practitioner will find it well to purchase a good instrument of each of the above-mentioned types. Once in possession of these, the ordinary exploring bladder cystoscope, used simply for examining the bladder-walls, is unnecessary. If, however, an instrument for that purpose is desired, the simple bladder-exploring cystoscope previously mentioned can be recommended. These cystoscopes have so small a shaft that they can be introduced very easily into the bladder through a urethra of comparatively narrow caliber without causing pain, and, consequently, by their use, the patient is less likely to become frightened. It is sometimes necessary, in order to obtain a correct conception of the position and appearance of the mouths of the ureters, to use the ordinary exploring cystoscope before employing the ureteral catheter cystoscope. Then, too, something is accomplished by accustoming the patient to the use of the cystoscope, particularly if the examiner believes that the ureters are to be catheterized more than once. For this purpose, also, the preliminary use of the ordinary exploring cystoscope is to be recommended.

How to Catheterize the Ureters with the Ureteral Catheter Cystoscope of the Straight Type.—So long as the operator is not thoroughly familiar with the method of catheterizing the ureters, as

well as for descriptive purposes, the bladder may, for practical purposes in using the catheter, be considered not exactly as a modification of a round body, but as a dome-shaped organ, having a bottom inclined to be flat and triangular in shape. This triangle is represented by the folds of the trigone on each side, while the prostate represents the apex.

One very important point that should be constantly borne in mind in using a catheter cystoscope of the straight type is that the instrument should never be rotated when it is desired to catheterize the ureters; rotation, in the observation of the writers, is perhaps the most common of all errors made by those who first attempt to catheterize the ureters with this cystoscope. The instrument should be used more as a lever. Always remember that the top of the beak should point toward the top of the bladder. Another important point that should be borne in mind is the part played by bladder folds. It is for the purpose of overcoming these folds as far as possible that we distend the bladder with fluid previous to the introduction of the instrument. The cystoscope, handled as a lever, with the bottom of the end of the shaft always firmly pressed on the floor of the bladder, prevents the folds of the prostate, or of the trigonal portion of the bladder, from rising too much and obscuring the view, and thus keeps the orifice of the ureter from getting behind the fold of the trigone to such an extent as to make introduction of the ureteral catheter impossible.

This latter annoyance will often vex the observer when the fluid placed in the bladder has escaped during the attempt at catheterization of the ureters.

In order to properly use the instrument, the bladder, emptied of urine, should be filled with from 8 to 12 ounces of a colorless aseptic fluid. It may be well to remark here that if urethritis or cystitis has been present, the bladder must be washed several times in succession so as to be perfectly free from shreds or mucus, which would tend to make the urine cloudy. With a clear and clean field, and about as much fluid in the bladder as it will comfortably hold, the instrument should be passed through the urethra in the classic manner, depressing the handle of the cystoscope well between the patient's legs before attempting to pass it into the bladder. This having been accomplished, the mandarin

removed, the light inserted, and the connection between the cystoscope and the battery having been made, the current should be turned on until the light of the lamp is almost white. The cystoscope should then be pushed backward until it meets the posterior wall of the bladder.

In looking through the eye-piece, the back wall of the bladder will be found to be a comparatively clear, light-colored field. The beak of the instrument should now be brought forward a little—not pulled straight outward, but brought forward—by raising the outer end of the instrument slightly toward the umbilicus and keeping the beak in the bladder well pressed down toward the bladder floor, the instrument being held in the median line, with the roof of the beak always pointing toward the roof of the bladder. A dark ridge will soon make its appearance at the bottom of the field as observed through the eye-piece. This is the apex of the prostate, and is also the apex of the triangle, which, for the inexpert, must be located before searching for the mouths of the ureters. Now, if the instrument is carried a little to one side, the dark-colored ridge of the trigone will be seen running off in a diagonal direction from this apex; and if the instrument is carried a little to the other side, but not rotated, a similar ridge will be seen. This ridge is a dark fold,—almost as dark as the apex of the prostate,—and a distinct line of demarcation exists between it and the lighter colored bladder-wall. About half way up this ridge, following along the edge of it (along the line of demarcation between it and the bladder-wall), and about an inch from the apex of the prostate, the mouth of the ureter is ordinarily to be found, but is at times located only after taxing the patience and watchfulness of the observer. It appears as a small elevation or slight blur. Occasionally the urine may be seen coming from it like a little puff of smoke. Having found the mouth of the ureter, or, if this has not been possible, having found the place where ordinarily it should be, the next point is to introduce the catheter. This is accomplished with more ease if the bladder is well distended with fluid. One difficulty may be met here—namely, the determining of the proper focus: the focus must be adjusted to each pair of eyes, and, as with an opera glass, the right focus for one person, is not necessarily that for another. The proper focus

must be obtained either by pushing the instrument a little more firmly against the bladder-wall or by drawing it outward, taking care to avoid lateral or rotary movement. This focusing is, as has been said, one of the most difficult parts of the operation, and requires practice and experience.

The catheter, on being pushed gently forward, no force having been used, and the proper focus having been found, except as in cases of malposition or of ureteral stricture, it enters the ureter. If in doubt, leave the catheter in position, withdraw the instrument a little, and, looking through the eye-piece, observe whether it has entered the ureter or is doubled up in the bladder.

The catheter having been introduced into the ureter on one side, the instrument should then be returned to the apex of the prostate and run along the border of the trigone on the other side until the orifice of the other ureter is found and the catheter introduced there. Then the shaft of the instrument may be taken out, leaving the two catheters in position, or, instead of introducing the catheter into the second ureter, it is preferable, in many cases, the fluid in the bladder having been entirely withdrawn, to allow the end of the catheter to remain in the bladder, while the other catheter would remain in the ureter. The urine from the other kidney would naturally flow through the catheter remaining in the bladder, provided no leakage from the kidney occurs around the first catheter placed in that organ. The two catheters having been left in this position, the patient's legs may be released from the rests, and he may be allowed to rest quietly and comfortably on his back while the urine passes through the catheters for half an hour or more.

The position of the legs of the patient while the catheter cystoscope is being used is an important feature. A pair of uprights should be placed on the table, from which are suspended two canvas stirrups for the patient's feet; the patient's body should be brought to the edge of the table, and, when adjusted, the lowest part of the canvas stirrups should be about sixteen inches higher than the edge of the table. Still better than the stirrups are the rests shown in our illustrations (Figs. 31 and 32).

How to Catheterize the Ureter with the Reverse Cystoscope.—*The Bierhoff Modification of the Nitze-Albarran Cystoscope.*—In using

this instrument the position of the patient and the intensity of the light should be the same as with the instrument previously described, but the operator does not see straight ahead with it, however, and with this form of cystoscope rotation is necessary. The field of vision is about that shown by us in the illustration of the field of vision of the Nitze exploring bladder cystoscope (p. 56). The cystoscope having been introduced with its beak pointing upward, the roof of the bladder will naturally first be seen. The instrument should now be rotated through an angle of about 75° and pushed slightly to one side. The field of vision now includes the point at which the ureters should be found. It may be advisable to turn the instrument completely about, so that the apex of the beak points directly downward to find the prostate and trigone ridge, and through the aid furnished by observation of their position, locate the ureter. The prostate and the trigone ridge in the use of this cystoscope will appear at the upper part of the cystoscopic field instead of at the lower part, as in the cystoscope of the straight type. The mouths of the ureters being located, the catheter should be pushed forward until its end strikes the mouth of the ureter. This extension of the catheter takes place under the eye of the observer. The instrument should then be very slightly withdrawn, and an attempt made, through bringing into use the metal finger on the instrument, to introduce the catheter into the ureter. One catheter having been introduced, search should be made for the mouth of the other ureter and the procedure repeated. Two manipulations should now be performed before withdrawing the cystoscope and leaving the catheters in position. The first consists in replacing the metal finger by means of the screw attachment, so it will not protrude in the withdrawal, as otherwise the urethra would be torn. The second step consists in loosening the screw at the outer end of the cystoscope, so that the beak can be rotated until it points upward without rotating the sheath that holds the catheters. Through this procedure the instrument may be withdrawn without pulling the catheters out of the ureters, as they will still be in the dependent portion of the instrument until it is removed. Constant practice and good eye-sight are important factors in making one expert in catheterizing the

ureters. Many of the difficulties previously encountered, such as large shafts to the instruments, inferior lenses, inadequate lighting facilities, and defective lamps that would easily burn out, have now been overcome by enterprising manufacturers. Very recently the Wappler Manufacturing Co. have, at our suggestion, made a single indirect ureter catheter cystoscope, which, while it cannot be recommended in preference to those already mentioned, is comparatively inexpensive and seems a useful and practical instrument.

Operative Cystoscopes.—Concerning the so-called operative cystoscope, through which a snare is placed or a cautery for the purpose of the removal or treatment of bladder tumors when deemed advisable, while no one has as yet succeeded in rivaling the wonderful results obtained by the late Dr. Nitze through the use of his operating cystoscope, and while criticism has been made in early editions of this work for recommending at all the use of operating cystoscopes, it is our firm belief that their field of usefulness is extending, and that, as familiarity with the use of the cystoscope increases, more and more work will be done through their instrumentality. It is not expected that they will ever supersede more pronounced operative procedures through the bladder-wall: still instrumentation through them

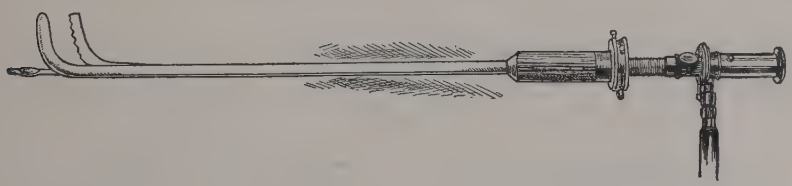


Fig. 39.—The Schapira universal cystoscope, showing lithotrite attachment.

on very small bladder tumors seems undoubtedly in certain cases to be attended with good results.

Through the use of the operative cystoscope the recurring growths previously operated on through bladder incisions may be treated, and two different types of high-frequency currents applied to bladder growths, cauterizing the same. With the Oudin current, the one most frequently used, the application is made through a wire attached to the instrument running through

the cystoscope and the application is made directly to the tumor. *Fulguration* is the name applied to this process. In applying the

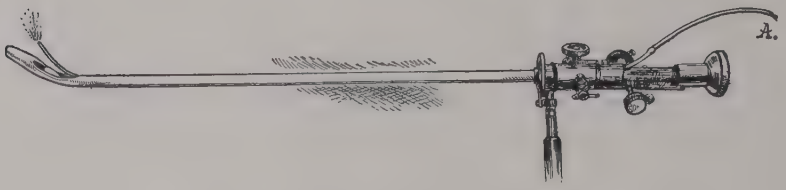


Fig. 40.—*A*, end of wire connecting with wire in Fig. 35.

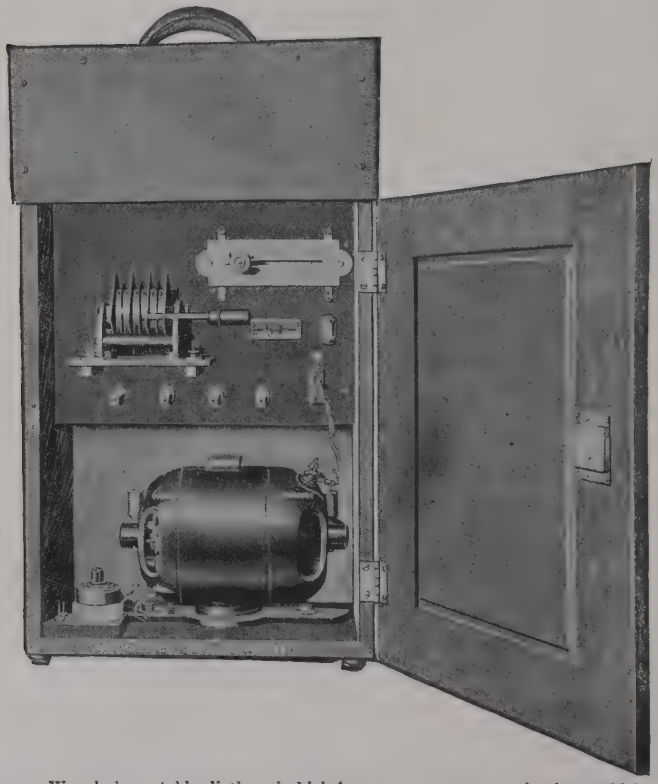


Fig. 41.—Wappler's portable diathermic high-frequency apparatus, wire from which connects with wire running through cystoscope. Another wire connects with indifferent tin electrode to be placed on buttocks.

spark to the tumor when the current is strong enough to act on the tissue a few air bubbles will be seen coming off from the spot where the current is applied, the bladder having previously been

filled with fluid. The part to which the wire has been applied is bleached. A little bit of tissue, white in color, becomes detached from the tumor and can frequently be seen floating in the fluid. When this appears it denotes that considerable necrosis has taken place. As a general rule the applications can be made about every three days of from fifteen to twenty seconds up to two minutes or more until the entire tumor has been thoroughly fulgurated. At first treatments should be made only for a short time, but each case studied by itself, the danger, of course, being that of burning through the bladder wall.

The d'Arsonval current has a somewhat similar action to the Oudin current. This is given by the application of an electrode to the body, generally over the abdomen, and another applied directly to the tumor.

Methods of Separating the Urine from Each Kidney without Catheterizing the Ureters

A year or two ago the consideration of the different methods of urine separation by the aid of various separators would have consumed more space than is at present demanded. So long as the difficulties of catheterization of the ureters seemed almost insurmountable, any new methods of separating the urine were received with decided enthusiasm; since, however, it has been learned that, once one is familiar with the process of catheterizing the ureters, the simple operation may be repeated as often as occasion demands, the various urinary segregators and separators have somewhat fallen into disuse and come to be considered unimportant. As time goes on it may be demonstrated that we are in error in making this observation. The fact remains, nevertheless, that at present an ideal segregator or separator does not exist; and although some of these instruments that are now in use are of value, and attest to the very commendable mechanical ingenuity of their inventors, still, the writers' experience and that of other investigators places them in favor of catheterization. It is the writer's belief that, in order properly to understand the use of segregators and separators, as much perseverance and skill are necessary as are required for catheterizing the ureters; and, from clinical experience, it would seem to be about

as easy to obtain consent for performing catheterization as for using the segregators. In exceptional cases, where the process of catheterizing the ureters has been so painful to the patient that he objects to further attempts at it, the segregators may be used. It is by no means intended to convey the idea that these segregators are valueless, for this is not the case. The Harris segregator is an instrument for which the profession should feel grateful. By its use, years ago, when it was first placed upon the market, the writers found unilateral albuminuria in cases of chronic nephritis, also casts in the secretion of only one kidney. At that time its use demonstrated how little was then known as to the nature of Bright's disease.

The Cathelin instrument has been used by the house staff of the City Hospital of New York with apparently satisfactory results in some cases. In a recent work entitled "Considerations sur la Methode de la Separation Intra-vesicale des Urines" ("Extrait des Annales des Maladies des Organes Genito-urinaires," 15. Janvier, 1906) Dr. Georges Luys has considered the different segregators very exhaustively. In general, segregators are of two kinds: first, those in which an instrument introduced into the rectum makes a bridge in the bladder; this is combined with a sound-shaped instrument that separates into two finger-like projections and presses the bladder into two pockets; the Harris instrument is of such a type; second, those on the order of the Luys or Cathelin instruments, which are sound shaped, but in which there is a rubber membrane that divides the bladder into two chambers.

TESTS SHOWING THE DEGREE OF KIDNEY PERMEABILITY

Tests for the estimation of the kidney function have been shown in the past few years to be of such importance that medical literature is becoming crowded with considerations of this subject. New tests are continually being brought forward and some of the earlier ones are necessarily pushed into the background. In previous editions of this work this subject has been considered with some detail, and particular attention was paid to giving the results as we have found them in our work rather than to theoretic considerations of matters concerning these tests with which we have had no personal experience. Originally, these tests were to a great

extent used with ureteral catheterization in an effort to show the condition of each kidney separately in relation to operative procedures. Lately, we have gone somewhat farther in the matter and have endeavored to devise a rather rough-and-ready test that could be used by the general practitioner as well as by the surgeon or laboratory worker, and which could be made, if necessity required it, in the office or at the bedside, believing that there is more demand for such a test than for those the carrying out of which is a very elaborate procedure.

We have purposely eliminated from this edition consideration of some procedures which have previously been discussed, either on account of their lack of practicability, or from the fact that the carrying out of them required such attention to detail as to relegate them to laboratory workers only. While many of these more elaborate tests have great value, a better study of them can be made from articles devoted to them exclusively, rather than in a work devoted to purely clinical subjects.

Among such tests considered by us in previous editions, but which we no longer use, are the methylene-blue test; the polyuria test (Albarran), and cryoscopy.

Since the last edition of this work we have carried on quite extensive investigations of the subject, but have used mostly three tests, each one of which we have found to possess considerable diagnostic value. We have used these tests in large numbers of individual cases, and also in a series of cases in which each of the three tests was used on the same individual, in order that the findings given might be compared and the relative accuracy of diagnosis and prognosis confirmed by further medical study by surgical operation or at the autopsy.

These three tests have been the estimation of the nitrogen in the urine compared with nitrogen retained in the blood according to the method of Otto Folin or some of its modifications ("Journal of Biological Chemistry," II, 1912, and Hawkes, "Practical Physiologic Chemistry"); the phenolsulphonephthalein and the phloridzin tests.

The **nitrogen test** has the disadvantage that it requires the services of an expert chemist familiar with detailed and elaborate laboratory methods usually to be found outside of a biologic

laboratory; but its results are so accurate that, on the whole, we find it the most useful of the three, and we believe it of great advantage both in the diagnosis and prognosis of renal deficiencies.

It is most important to note, however, that for the accurate use of this method a constant, determined, and low nitrogen diet must be first given.

As yet the methods differ considerably. Some, as Chase, Halsey, and their students, do a nitrogen partition on the filterable blood nitrogen, and as a result apparently feel that the gravity of prognosis hangs chiefly on the creatinin present; while others, as Larken, at the City Hospital, place greater reliance on the total filterable nitrogen present. This last method, which we have chiefly employed, is by far the more simple, nor do we find that it suffers thereby in accuracy.

The idea has been rather recently advanced that the abnormal retention of uric acid in the blood is one of the early precursors of renal incompetence. Certainly a huge blood uric acid content is present in nearly all cases of kidney deficiency, but whether it is an accompaniment or a true index of this state is still in question. Certainly in such instances the differentiation from gout, with or without renal defects, is most difficult chemically. When a broad comprehensive clinical view of a case is taken, however, as we have observed it, little likelihood of error is possible.

At first heralded as an almost infallable prognostic sign, retention of filterable blood nitrogen has now been shown to be influenced by many factors, as by food, excretion by other avenues, or by medicinal agents. When, however, the blood nitrogen remains constantly high or does not decrease under treatment, it must be certainly considered as among the most certain and absolute of bad prognostic signs.

Phenolsulphonephthalein Test.—This is a color test for determining kidney permeability which has recently been introduced to the profession for that purpose by L. G. Rowntree and J. T. Gerachty,[1] its pharmacology having been previously studied by

[1] "An Experimental and Clinical Study of the Functional Activity of the Kidneys by Means of Phenolsulphonephthalein," Journal of Pharmacology and Experimental Therapeutics, vol. i, No. 6, July, 1910.

Abel and Rowntree.[1] Its method of administration is as follows:

Twenty minutes to half an hour before commencing the test the patient is given 300 to 400 c.c. of water in order to insure a free urinary secretion and prevent delay in time of appearance. Catheter introduced and the bladder emptied. Catheter allowed to remain; 1 c.c. of phenolsulphonephthalein solution containing 6 mg. to the cubic centimeter is administered subcutaneously or intramuscularly. The solution is prepared as follows: 0.6 gram of phenolsuphonephthalein and 0.84 c.c. of $\frac{2}{N}$ NaOH solution are added to 0.75 per cent. NaCl. solution. This gives the monosodium or acid salt, which is red in color and which is slightly irritant locally when injected. It is necessary, therefore, to add two or three drops more of the $\frac{2}{N}$ hydroxid, a quantity sufficient to change the color to a beautiful Bordeaux red. This preparation is non-irritant. The urine is allowed to drain into a test-tube in which has been placed a drop of 25 per cent. NaOH solution. Time of appearance of first pinkish tinge is noted. Then urine is collected for one hour, care being taken to see that the bladder is thoroughly emptied and the time taken. Then the urine is collected for the second hour and the time taken. Each sample of urine is measured and specific gravity taken. Enough of the 25 per cent. NaOH solution is added to make the urine decidedly alkaline in order to elicit the maximum color. In acid urine the color is yellow or orange, which becomes purple-red when the solution is made alkaline. The solution is then placed in a liter measure-flask and distilled water added to make accurately 1 liter. The solution is then thoroughly mixed and a small filtered portion is taken to compare with the standard which is used for all these estimations. The use of a colorimeter is required, the Duboscq being the one recommended for the purpose.

Quoting from the work referred to, the remainder of the process is as follows:

"The standard solution used for comparison consists of 3 mg. of phenolsulphonephthalein (or $\frac{1}{2}$ c.c. of the solution used for injection) diluted up to 1 liter and made alkaline by the addition of only one or two drops of 25 per cent. NaOH solution. This is a

[1] Journal of Pharmacology and Experimental Therapeutics, vol. i, p. 231.

beautiful purplish-red solution, retaining its intensity of color for weeks or for an indefinite period. The one solution, therefore, serves for an immense number of tests.

"One cup of the colorimeter (right) is half-filled with this standard solution used for comparison, which has just been described, and the plunger lowered so that the indicator reads at 10. A varying quantity (depending on the intensity of the color) of the diluted urine is placed on the other cup, and the plunger manipulated until the two halves of the field are of an identical intensity of color. The indicator of the left plunger is now read, the fraction, as indicated by the Vernier scale, being taken into account. The estimation of the quantity present is then a question of simple arithmetic.

"For instance, the left side reads at 20—the standard being placed at 10. In other words, it takes a column of fluid twice as long to give the same intensity of color as that of the standard, which, of course, shows that the solution contains only half as much as dye. To obtain the percentage of dye excreted in the urine compared with the amount in the standard solution used for comparison it is necessary to multiply the reading of the standard by 100 and divide by the reading indicated for the solution containing the urine. To return to our example: we have $\frac{10 \times 100}{20}$ = 50 per cent., as much drug in the urine as in the standard solution used for comparison.

"The 3 mg. to the liter standard for comparison has been chosen arbitrarily because of the beautiful pink color which is obtained when the indicator stands at 10. The amount of drug used for injection is 6 mg. chosen for reasons stated above. We have compared the amount of drug in the diluted urine with that of the standard for comparison, but, if we wish to estimate the amount of drug excreted as compared with the amount of drug administered, we must compare the amount excreted with 6 mg. rather than 3 mg., which is present in the solution for comparison. In the example given above we would have 50 per cent. of the 3 mg. or 25 per cent. of the 6 mg., which was the amount injected; so that the excretion is 25 per cent. of the amount administered."

Quite satisfactory results may also be obtained by the simple and inexpensive Dunning colorimeter.

A slight source of error may be present if the patient excretes more than 200 c.c. of urine an hour. Methods for overcoming this error are described in the article referred to.

Rowntree and Gerachty in their study of normal cases found the time of appearance varied from five to eleven minutes and that 40 to 60 per cent. of the drug was excreted in the first hour and from 20 to 25 per cent. in the second hour, that from 60 to 85 per cent. was excreted in two hours, and that the excretion of the drug does not run parallel to the excretion of water.

This test may be very conveniently employed either in the office or home and does not require hospital or elaborate laboratory study.

Phloridzin Test.—In previous editions of this work we have stated that we consider this latter test the most practical. Farther experience with its use has demonstrated the general correctness of the views then held, though in intern work the first two methods are more useful.

In the comparative series of cases mentioned above it was found by us to be but slightly less accurate than the nitrogen determination studies, and slightly more so than the phenolsulphonephthalein test. The resemblance of the results obtained from each of the three tests is very close, but the phloridzin test is the one recommended by us for routine surgical work. The findings from its use, however, should be checked up by one or both of the other tests mentioned, when in doubt. All of these tests are of use in connection with ureteral catheterization, but in our endeavor to find a simple test, without that procedure, the phloridzin more than any other meets surgical requirements.

We recommend a solution of phloridzin 1 : 400, of which 30 minims are to be injected subcutaneously in the gluteal region. This solution is twice as much in quantity and contains one-half the amount of phloridzin previously recommended by us, but has the advantage of being a stable solution.

Thirty minutes after the injection in a normal individual a trace of sugar should be found in the urine by one of the ordinary fairly accurate tests, such as Benedict's or Whitney's.

The presence of sugar in thirty minutes is proof positive that the kidneys are in a fairly healthful condition, or at least doing their work, but the converse to the above proposition is not correct.

The absence of sugar in thirty minutes can be taken to demonstrate that there is some interference with proper tissue metamorphosis, most generally due to some impairment of the kidney function, but it may be due to a variety of other causes, such as arteriosclerosis, malignant growths, or various disturbances of the nervous system. Therefore when sugar is found to be delayed or absent, it is an indication that a still more exhaustive examination of the patient should be made and further investigations of the urinary secretion made. Not infrequently sugar is absent from forty-five minutes to one or two hours, or may not appear at all. As a general statement it may be said that the longer the delay in the appearance of sugar, the more extensive probable renal changes are. In cases of enlarged prostate with residual urine the bladder should be emptied before the phloridzin is injected and the catheter allowed to remain in the bladder during the time that the test is being carried on. This procedure can, of course, be used in other cases if deemed necessary.

Though we all recognize the great and increasing value of these tests, they in no way invalidate or supercede the older methods, as the careful examination of the urine and especially the general clinical consideration of any case. The new methods assist us very greatly especially as to accuracy in prognosis and diagnosis, but they cannot replace the older and fully established methods of the study of renal diseases.

Test Showing Permeability of the Kidney Associated with Ureter Catheterization

More and more attention is being paid to this subject on account of the great importance in kidney operations of finding out the functional value of the kidney which is not to be operated on. This is of particular importance when both kidneys are diseased, but in different degree.

In addition to whatever information may be obtained by palpation, by massage over the surface of each kidney separately, by the appearance of the mouths of the ureters through the cysto-

scope, by the ease with which ureter catheterization is performed, and by any other general measures which may suggest themselves, we recommend the following tests for this purpose: The indigo-carmin test, the phloridzin test (details mentioned above), and a very simple but useful test reported by F. Voelcker, of Heidelberg (Report of the International Congress in the Journal d'Urologie, August, 1914, vol. vi, No. 2), *the water test.*

These tests are valuable, particularly in cases of tuberculosis, where both kidneys are affected. In commencing tuberculosis one frequently encounters the symptoms of hypo-azoturia, in which there is a polyuria with clear urine, but in which the kidney is not able to give a concentrated urine.

Indigo-carmin Test.—Voelcker and Joseph, who devised this test, found that indigo-carmin injected hypodermically is excreted by the kidneys as a blue coloring-matter. They dissolved 0.4 gm. of carmin in 10 cm. of physiologic salt solution and injected 4 gm. into the gluteal muscle. The coloring-matter normally makes its appearance in the urine about ten minutes after the injection. In order that the urine may be concentrated they limit the fluid intake before the test. Later the injection of 20 cm. was recommended, in which case the reaction occurred in from three to five minutes and the height of excretion was attained in from one-half to three-quarters of an hour. Delayed reaction indicates renal insufficiency. Kapsammer states that the power of the kidney to excrete may be also advantageously tested by reducing or increasing the concentration of the solution.

This test in our experience is of considerable value associated with catheterization of the ureters so as to indicate the condition of each kidney separately. The difficulty that we have found with it for general work is that it is not elastic enough, the variations in color being so slight that the data given through its use is not exhaustive enough to render a very valuable aid except to the extent above mentioned.

The Water Test.—The proof by means of thirst is then instituted, that is, an attempt is made by withholding fluid to see if the kidney has elasticity enough to secrete fluid of a higher specific gravity. If the kidney is found to perform this function satisfactorily, in order to test it to see whether such results are simply causal or not

a large amount of fluid is then ingested to see if the same kidney will again produce urine of a low specific gravity. On the other hand, if a kidney is found in which the specific gravity is high, a large amount of fluid is ingested in order to see if the specific gravity of the urine becomes lower, and in order to test this too for what may be termed its elasticity. As a check a small amount of fluid is then only permitted to be ingested to see if the urine specific gravity becomes high again. To illustrate, in profuse parenchymatous nephritis or large lesions which occupy almost all the kidney, where the urine is of low specific gravity, such kidneys are supposed to be unable to secrete urine whose gravity is of a marked higher gravity.

Where it is practical in any given case more than one of these tests should be tried, so that the results of one may check up the findings of the others. Particularly true is this in tuberculosis of the kidney. It is becoming more and more recognized that tuberculosis of the kidney either directly involves both kidneys or while one kidney may show the active lesions of it, the other kidney is very prone to show at least the evidence of some simpler inflammatory process. This matter will be again referred to under the subject Tuberculosis of the Kidney.

It should be borne in mind that when it is practical to carefully carry out these tests a great aid is furnished by their findings in a certain proportion of cases. Just how great it is hard to state. The evidence given by the ordinary laws of surgical procedure should take precedence over the evidence furnished by these tests. This particularly refers to septic conditions associated with kidney abscesses.

Sometimes it is impossible to catheterize the kidneys in these cases. Under such conditions information must be obtained from the twenty-four-hour urine, general examinations of the blood, and such procedures as the estimation of nitrogen in the blood.

We also wish to call attention to the more recently published tests by Herman O. Mosenthal in the November, 1915, issue of the "Archives of Internal Medicine," entitled "Renal Function as Measured by the Elimination of Fluids, Salt, and Nitrogen, and the Specific Gravity of the Urine." Also the paper of Prof.

Theodore C. Janeway, of Johns Hopkins, entitled "Management of Patients with Chronic Renal Disease."

These papers contain a very elaborate set of statistical tables of the reaction of normal and nephritic individuals to the so-called "nephritic test meal," in which the quantity of urine eliminated as well as the output of nitrogen, sodium chlorid, and the specific gravity have been carefully estimated. Space does not permit our going more into detail, but we feel sure that it will be well worth while for those interested to investigate these articles for themselves.

CHAPTER III

THE CARE OF URETHRAL INSTRUMENTS.—PREPARATION OF PATIENT FOR OPERATION AND AFTER-CARE

THE CARE OF URETHRAL INSTRUMENTS

Casper has well stated that many aseptic conditions in the urinary tract may be rendered septic by uncleanly instrumentation. Zuckerkandl insists that catheterization should be regarded in the light of a surgical operation, and that preparations for carrying it out should be made with the same precaution as regards asepsis as are observed in performing operations on other portions of the body. It may be stated, also, that no amount of aseptic care regarding the hands of the operator, the sterilization of the instruments, or the preparation of the field of operation will render a trauma in the urethral tract caused by instrumentation harmless. The ease with which instrumentation can be carried out depends largely on the personality of the operator. Some men, even those of large experience are apparently regular bunglers in this respect. As regards cleanliness, sterilization of instruments, and preparation of the field of operation, however, personal equation is not a factor, since these procedures can be carried out by any operator who will give to the matter the time and patience required.

Sterilization should not, however, be carried to the point of excess. In following the instructions laid down by some writers one is likely to produce irritation in the too strenuous effort to secure cleanliness. Illustrative of this overanxiety to obtain an aseptic field is the much-recommended practice, previous to inserting a catheter into the bladder, of washing out the anterior urethra with a solution of silver nitrate (one or two grains to the ounce) in the hope of rendering sterile any shreds that may remain in contact with the urethral walls. The too prolonged application of soap poultices for the purpose of loosening up the layers

of the superficial epithelium preparatory to operating will also prove irritating.

The following method for the care and sterilization of instruments and for the preparation of patients, in use in the City Hospital of New York, has stood the test of time and is easily followed.

Soft-rubber instruments, such as soft-rubber catheters, are boiled for five minutes in water to which washing-soda has been added, the proportion being a teaspoonful of soda to the gallon. They are then wrapped in sterilized gauze and kept in covered glass jars. Before being used they may be soaked for five minutes in 1 : 20 phenol solution, this to be washed off in a 4 per cent. boric-acid solution.

Not only the soft-rubber instruments, but also silk catheters and bougies may be boiled. The best way to do this is to wrap them in a piece of sterile gauze before boiling. When boiled, remove them still wrapped in the gauze with the fingers and place them in a cool solution. Boiling softens the lacquer that covers the silk instruments, and they are likely to suffer indentation if, while hot, another instrument is allowed to come in contact with them. This can be avoided by the use of the procedure mentioned above. Silk instruments may also be disinfected by immersing them for five minutes in a 1 : 20 phenol solution and then washing in boric acid 4 per cent., or they may be soaked in a 1 : 10 of 1 per cent. formaldehyd solution. It is recommended by many—and has come to be quite the general custom—that catheters be disinfected by preserving them in a glass jar having formaldehyd at the bottom, formaldehyd gas being generated; or that they be kept continually soaking in a 0.5 per cent. formaldehyd solution. Experience at the City Hospital seems to show that when either rubber or silk instruments are continually exposed to the fumes of formaldehyd vapor, or are immersed in a solution of formaldehyd of a strength of 0.5 per cent. or stronger, they soon become worthless. In private practice the writers have disinfected rubber and soft instruments by subjecting them to the action of formaldehyd vapor in the sterilizer described below, the vapor being generated by the heating of a formaldehyd lozenge. After a few minutes the instrument is removed and wrapped in sterile gauze. When time will not permit,

or when the ordinary forms of sterilization are not available, a strong solution (2 to 4 per cent.) of formaldehyd may be used and immediately washed off. When frequent irrigations are to be made through a small olive-pointed gum silk catheter, a plan to be recommended in private practice is that of keeping each patient's instrument separate, thus reducing the danger of carrying infection by means of the catheter from one patient to another.

Steel instruments are sterilized by boiling them for five minutes

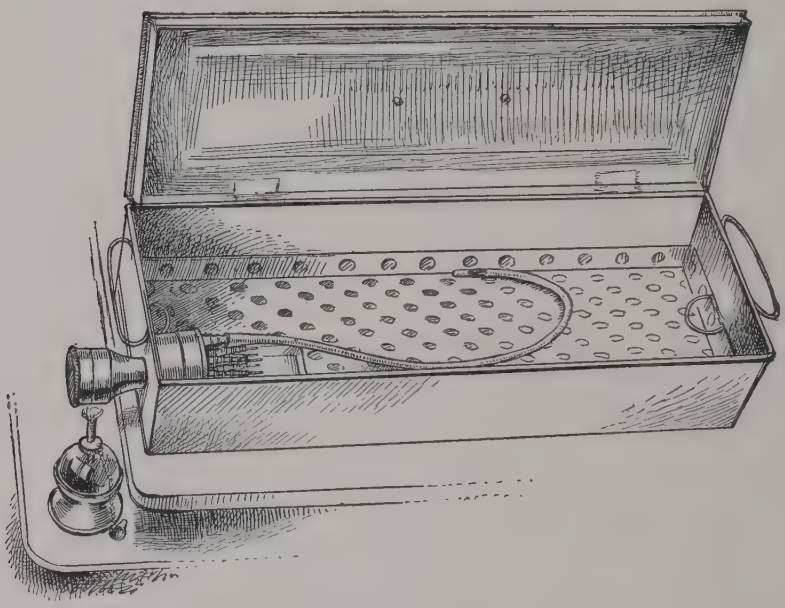


Fig. 42.—Formaldehyd sterilizer for catheters and small instruments.

in a solution composed of a teaspoonful of soda to a gallon of water; they are then dried, wrapped in sterilized gauze, and placed in a glass jar with a cover; they may be then soaked in a 1 :20 phenol solution for five minutes, being washed off, just before using, in a 4 per cent. boric-acid solution. For office practice, a small steam instrument-sterilizer works very well.

A sterilizer is used by the writers in which steam is generated; it is heated by means of an electric worm on the inside of the sterilizer, which is brought into immediate contact with the water.

The coil running from this apparatus is easily attached to the electric-light fixture, and the instrument has proved very practical. Care should be taken, however, that water is always present in the sterilizer.

Some advise the addition of a small amount of ammonium chlorid to the water in which instruments are to be boiled. A solution of mercury bichlorid (from 1 : 5000 to 1 : 3000) is a useful disinfectant, but has the disadvantage of turning metal instruments dark and of eroding their surfaces. A strong solution of formaldehyd in glycerin may also be used. The vapor of sulphu-

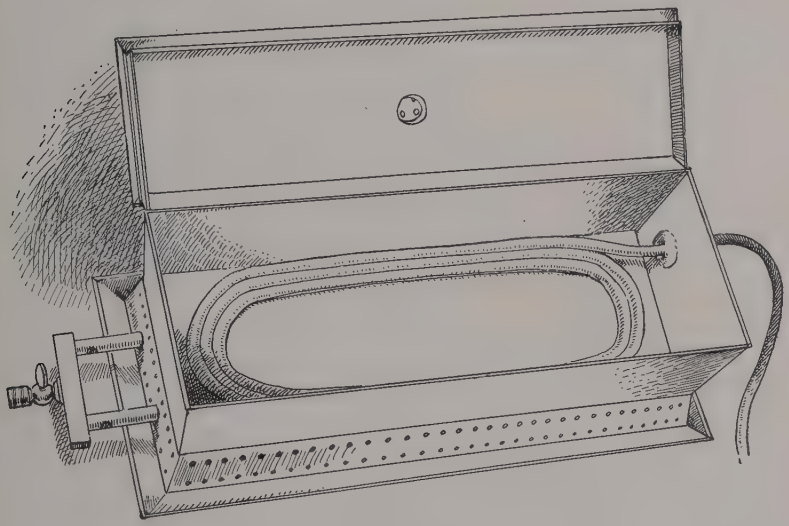


Fig. 43.—Showing electric coil for boiling water in sterilizer.

rous acid has been employed as a disinfectant, but the simplest and most satisfactory method of sterilization is that accomplished by boiling water.

Cystoscopes may be disinfected by soaking them in 1 : 20 phenol solution, care being taken not to wet the inside of the lenses; before using, the instrument may be washed off in a 4 per cent. boric-acid solution. Cystoscopes are best disinfected by allowing them to remain for a short time in the formaldehyd vapor generated in the formaldehyd sterilizer previously described.

After use, instead of allowing it to lie in the phenol and boric-acid solutions, the cystoscope may be again subjected to the action of formaldehyd gas, washed off with soap, and then with a solution of ether or lysol.

Urethral catheter cystoscopes are difficult to clean, and every part must receive separate and careful attention.

Cystoscopes may be rubbed with green-soap spirit, and afterward with alcohol to remove the green soap. Removable parts should be boiled. Fresh solutions for each disinfection should be made up from a stock solution.

The general rule in use for the sterilization of cystoscopes is applicable to lithotrites and their evacuators and to Kohlmann dilators. Some of the evacuators on the market, such as the new Kraus, the Otis, and the Chismore, are comparatively easy to sterilize, whereas others are so constructed as to present greater difficulty.

In the case of dilators that are covered with rubber, it is necessary to sterilize the rubber as well. This may be done in various ways—by immersion in solutions of phenol, followed by immersion in boric acid; by the application of formaldehyd vapor, the rubber being placed over one of the combs in the formaldehyd sterilizer, according to the method shown in fig. 42. By keeping different rubber coverings for individual cases the danger of carrying infection is minimized.

Lubricants.—The ideal lubricant for the passage of urethral instruments is yet to be discovered. If it were desired merely to make the instrument slip into the urethra with ease, vaselin or the various oils distilled from the coal-tar products would answer the purpose. As is well known, however, these substances form a coating in the urethra that hinders the penetration of any medicament it may be desired to apply to the urethral wall. Glycerin with boric acid is an excellent lubricant. For this purpose it is the writers' custom to use Price's English Glycerin, as this seems to have more body than the ordinary glycerin of commerce. The fact that glycerin acts as an irritant on some persons, combined with the fact that instruments lubricated with it will not penetrate quite so easily as those lubricated with vaselin, lessens

its usefulness. In this country, at present, a great many preparations are being used that have Irish moss as a base, formaldehyd in varying proportions being added for its antiseptic properties. These are proprietary articles, and in most cases the formulas are not definitely given. Their disadvantage lies in the fact that the jelly of the Irish moss may be lumpy, and that the preparation is not so easily removed from instruments as is glycerin. In private practice the writers occasionally use a preparation called formical, manufactured by John Carl and Sons, New York city; in this the purified chondrin jelly made from Irish moss is combined with a certain proportion of a formaldehyd solution.

The following formula (known as "Katheterpurine") is prescribed by Casper, and is used to some extent in this country. It has occasionally given rise to irritation of the urethra when the membranes were very sensitive; it should be made weaker:

℞. Oxycyanid of mercury, ... 0.246
Glycerin, ... 20.
Gum tragacanth, ... 3.
Water, ... 100 M.

Kraus uses gum tragacanth, 2.5 per cent., glycerin, 10 per cent., and a 3 per cent. solution of phenol. Owing to the quantity of water it contains, this can easily be washed off.

Guyon's pomade is made of equal parts of glycerin, water, and soap.

In Germany oxycyanid of mercury is being used extensively in lubricants. For cystoscopes the glycerin and boric acid is probably the best. Cleanliness should be observed as regards the bottles or other receptacles in which lubricants or substances to be used for purposes of irrigation or instillation are to be kept. Dust should not be allowed to accumulate on the outside or on the inside. The receptacles should be of a type that can be boiled. Silver nitrate solutions should, of course, be kept in covered dark bottles.

PREPARATION OF PATIENT FOR OPERATION

At the City Hospital the method of preparing patients for operation is as follows: When catheterization or simply an examination of the urethra is to be carried out, the glans penis and the neighboring parts are washed off with a bichlorid solution 1:5000 or 1:3000, and sterilized towels and a piece of sterilized gauze placed around the base of the shaft of the penis.

As previously stated, neither in hospital work nor in private practice is it necessary or advisable, previous to the introduction of an instrument, to attempt disinfection of the urethra by means of irrigations or disinfecting fluids, particularly silver nitrate solutions. Neither is it necessary, as a routine measure, if it is desired to pass fluid beyond the compressor urethræ muscle, to overcome the contraction of the muscle by forcibly distending the anterior urethra by fluid. In examining the bladder, it is the writers' general practice to introduce into it an antiseptic solution, such as boric acid or oxycyanid of mercury, through a small olive-pointed French gum catheter. If some more serious operation than simple examination of the bladder or urethra is to be performed, the method of procedure is as follows:

Before operation the instruments are, of course, properly sterilized. In the preparation of the skin some distinction is

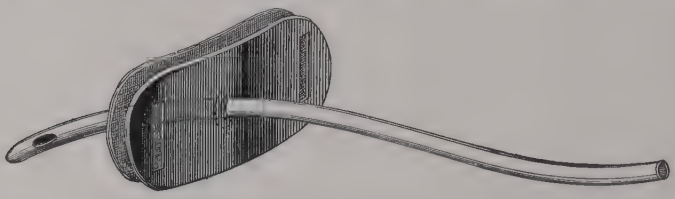


Fig. 44.—Plate to secure catheter in suprapubic drainage.

made as to whether the operation is one in the neighborhood of the kidney or such a one as suprapubic cystotomy; or an operation on the external genitals, testicles, or a perineal section is to be made. In the former the patient is scrubbed up, the field of operation is washed with soap and water, followed by alcohol, the surface scrubbed with alcohol and ether, and a dry dressing is applied. At the time of the operation, without any further washing, tincture of iodin is painted over the site of the incision and allowed to dry before the cut is made. Following the operation in many condi-

tions it is wise to paint the inside of cavities with the same solution of iodin as used on the surface of the skin. After operation on the kidneys sterile gauze or dry sheet gauze is applied, this being covered with folded gauze; next a binding dressing is applied consisting of absorbent cotton placed between two pieces of sterile gauze, and this is covered with a many-tailed bandage, and if a tube is introduced additional dressing is required. In operations on the lower genitals, on account of its occasional irritating effects on the skin, tincture of iodin is not used; the patients may be scrubbed up just before operation. In the preparation of a patient for perineal section alcohol and ether should not be used about the genitals, but, instead, bichlorid 1 : 2000 should be employed.

For *suprapubic section* the field of operation is also prepared as in the manner above described. If a drainage-tube is introduced through the suprapubic opening into the bladder and it drains well, the dressing need be changed but once a day; where there is much leakage around the tube, the dressing should be changed more frequently. Strip gauze should be placed around the tube, covered by plenty of fluff gauze, and a combined dressing with a hole in the center applied, being retained in place by strips of adhesive plaster over and on each side of the tube. If no tube is inserted in the suprapubic opening, or after removal of the tube, it is necessary to change the dressing every three or four hours. Frequent change of dressings should follow

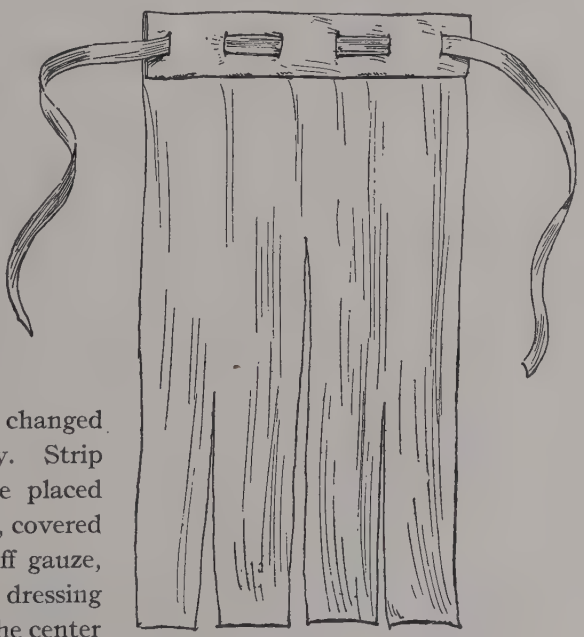


Fig. 45.—Dressing for perineal section.

suprapubic cystotomy to prevent the formation of suprapubic fistula.

In *operations on the testicle* the dressing consists of fluff gauze placed over the wound, combined dressing over this, and a handkerchief bandage support covering all. This handkerchief bandage support or triangular bandage is very serviceable, and is probably so well known that a description is unnecessary.

Zuckerkandl advocates cleansing the pubes, glans penis, and meatus with soap and water, fo lowed by a bichlorid wash, and, as before stated, washing out the anterior urethra with a silver nitrate solution 1:2000, so as to render any shreds that may be present

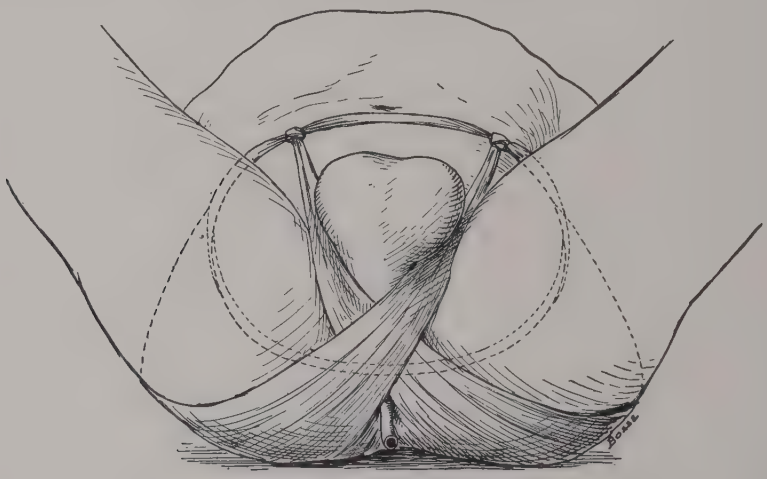


Fig. 46.—Dressing for perineal section.

in the anterior urethra antiseptic; these shreds would otherwise, if washed back into the bladder, start up an inflammatory process. He advises that catheters be not sterilized until immediately before use. His method of applying the spica bandage over the shaft of the penis, over the glans, running down on to the shaft of a retention catheter, the other end of the catheter being in a container passed through sterile cotton in its neck, has been elsewhere described. He considers that retention catheters will occasionally start up not only a urethritis, but a diphtheric inflammation of the urethra as well.

For bladder washings he recommends oxycyanid of mercury

1 : 5000 in place of boric acid. He considers that antiseptic bladder washings before the introduction of such an instrument as a cystoscope will sometimes obviate the necessity of resorting to antiseptic bladder washings after the removal of the instrument. His suggestions as regards the sterilization of instruments before performing lithotrity are of value. He recommends that the pumps be sterilized and placed in bottles filled with bichlorid solution, where they should be left until required. Just before operation the bichlorid can be removed and boric acid solution substituted as a washing-out fluid. He quotes Guyon as advocating silver nitrate 1 : 5000 for sterilizing the pumps. Kraus has invented a glass pump that is now on the market that should be easily rendered sterile.

The measures advocated by Zuckerkandl for preparing the patient for the operation of litholapaxy are as extensive as those followed when a serious operation is to be performed. Beginning with the usual bichlorid solution, soap poultices, etc., disinfection of the hands of, and the wearing of sterile clothes by, the operator, he recommends the prolonged washing-out of the urethra and bladder with the boric-acid solution before the lithotrite is introduced; his general recommendation as regards the frequent washings of the bladder during litholapaxy are somewhat at variance with the recommendations of Chismore, quoted elsewhere. Zuckerkandl, who has written extensively on asepsis in connection with surgery of the urinary organs, recommends that, even for so simple an operation as urethrotomy, the antiseptic details should be the same as in operations of greater consequence.

Anesthesia.—As regards general anesthesia, our experience has been that the best results are obtained when it is induced either by the drop method, or with a combination of nitrous oxid and ether, as with the Gwathmey inhaler, oxygen gas, and ether. The reader is referred to general instructions on the subject of anesthesia a little later on following the consideration of spinal anesthesia and following methods of local anesthesia. Anesthesia through intravenous injection is being practised to some extent in Russia, but has never been attempted by us, nor, so far as we know, have many reports on that method been published in this country.

Rectal anesthesia is becoming increasingly popular, but we have not employed it as yet because of its apparent uncertainty of dosage.

Spinal Anesthesia.—This method of procedure, though so popular at the present time among many surgeons in this country, we strongly advise against. The main advantage claimed for it, which is of apparent credit, is that it is less irritating to the kidney than ether and chloroform. This is more than offset by the disadvantages associated with its use. The death-rate, though low, we believe to be higher than that following either ether or chloroform. Our personal experience with it has been unfortunate. Another and very important objection urged against it by one of the foreign observers is that in case of any unpleasant symptoms associated with its administration, the surgeon, through the nature of the anesthesia, is unable to control the situation to any extent and administer any emergency treatment, as can be done with general anesthetics introduced in the usual way.

Local Anesthesia.—While we are opposed, as mentioned above, to the use of spinal anesthesia for the reasons given, we are heartily in accord with the workers who are endeavoring to extend the field of local anesthesia. *Local anesthesia* for operations on the urinary system are becoming more and more popular, and, we believe, deservedly so. These procedures can be administered in two general ways: the infiltration method, by which the conductability of the nerves emerging from the spine are affected, and the direct local injection method. Ordinarily both these procedures can best be carried out with the solution of Reclus, the formula of which is as follows:

Normal salt solution, 100 gm.; novocain, 50 c.g.; adrenalin (1 : 1000 solution), 25 drops.

One c.c. should contain $\frac{1}{4}$ drop of adrenalin.

Where small quantities only are required locally, in such minor operations as circumcision and simple skin incisions, a 2 per cent. cocain solution is recommended.

Conduction Anesthesia in Genito-urinary Surgery.—We recommend the following works to be carefully studied by every surgeon who is interested in this method of procedure, as space scarcely permits us to give all the necessary details the following out of

which will be attended with the best results. The two works recommended are, "Local Anesthesia: Its Scientific Basis and Practical Use," by Prof. Dr. Heinrich Braun, translated by Percy Shields, M. D., A. C. S.; "Local and Regional Anesthesia," by Carroll W. Allen, M. D. (W. B. Saunders Co., Phila.).

Conduction anesthesia is recommended by Braun for operations on the kidney, on which he has performed several using the technic of Kappis. "Three nephrotomies were performed in the following manner (Figs. 47 and 48). In each of the cases it was possible to determine the exact extent of the anesthesia. The eighth to twelfth dorsal nerves were each blocked with 5 c.c. of 1 per cent. novocain-suprarenin solution. The points of entrance were placed in a line continuous with the outer edge of the quadratus lumborum muscle. Another point was marked on the outer edge of the quadratus muscle at the crest of the ilium. From this point and the point marked for the twelfth dorsal a strip of tissue extending to the kidney fat was infiltrated thoroughly with about 75 c.c. of 0.5 per cent. novocain-suprarenin solution. No further injections or circuminjections were necessary, as the anesthesia of the skin was extensive, as shown in Figs. 47 and 48. The operations were absolutely painless, were performed upon lean persons, and the kidney was easily accessible. The luxation of the kidney was painless. There is, therefore, every reason to believe that local anesthesia will soon be used for kidney surgery."

For blocking the nerves, generally speaking, the procedure is to insert the needle back of the lumbar arch, so that the nerves can be deadened as they emerge from their foramen. For the infiltration into the skin and muscles two injections are made in three planes, one plane to reach the deep muscles as far as the periosteum, a more superficial plane for the cellular tissue, and a third for the skin. Attention is again called to the necessity of reading the two volumes above mentioned.

The above method can be used for the kidney and ureter. Conductability anesthesia, either by itself or associated with direct local anesthesia methods, where the purpose is to deaden the nerve of the prostate and bladder, is best performed through what is called the parasacral method, in which the nerves lower down the spine than for kidney operations are deadened. Investigators are

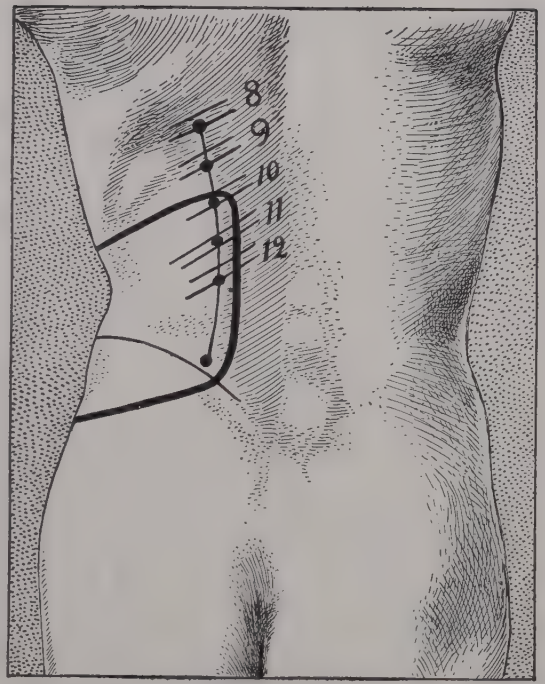


Fig. 47.—Technic of anesthesia for kidney operations. The continuous line indicates the extent of anesthesia. Back view. (Redrawn after Braun.)

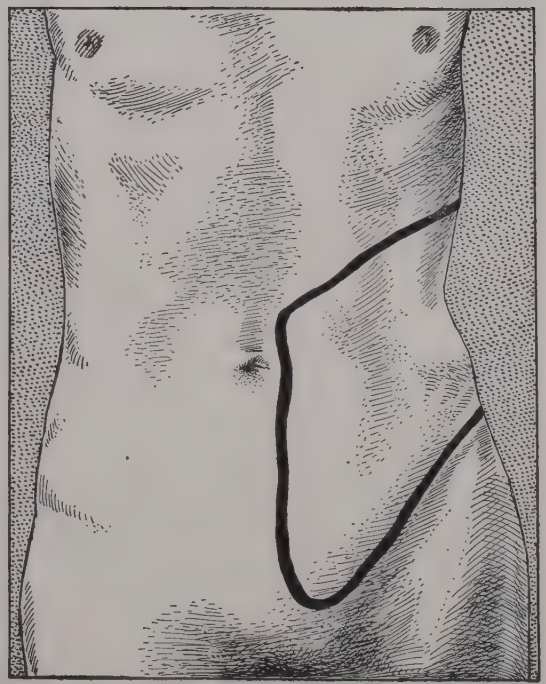


Fig. 48.—Technic of local anesthesia for kidney operations. Front view. (Redrawn after Braun.)

The eighth to twelfth dorsal nerves were each blocked with 5 c.c. of 1 per cent. novocain-suprarenin solution. The points of entrance were placed in a line continuous with the outer edge of the quadratus lumborum muscle. Another point was marked on the outer edge of the quadratus muscle at the crest of the ilium. From this point and the point marked for the twelfth dorsal a strip of tissue extending to the kidney fat was infiltrated thoroughly with about 75 c.c. of 0.5 per cent. novocain, suprarenin solution.

referred to the books previously mentioned for the details of that procedure. Personally we have not found it necessary, and are inclined to the belief that for the removal of prostates or even bladder tumors, save in exceptional cases, direct local anesthesia methods are all that are required. It has been used by us for such operations as prostatectomy. According to the method of Legueu (Journal d'Urologie, 1914, vol. v), the amount of the Reclus solution that is used for a prostatectomy is from 60 to 80 grams, and for the wall including the opening of the bladder, 60 to 70 grams of the solution—in all, 130 to 140 grams of the solution. Total quantity of the anesthetic is 0.60 to 0.80 c.g.

A slight amount being injected into the skin over the rectus muscle in the plane in which the incision is made, the incision is carried down to the bladder wall. When the bladder wall is reached inject 8 or 10 gm. of the solution, diffusing it from right to left into the thickest part of the bladder wall. Also place 10 to 20 c.c. of the solution mixed with the liquid used for distending the bladder. With the bladder opened, the fingers of the left hand are placed gently over the prostate. Into the prostate is injected in the line of cleavage through seven or eight different punctures, for each puncture 5, 7, or 10 c.c. of the solution, according to the size of the prostate.

Legueu had some special needles constructed (Fig. 49), 20 to 30 cm. long, of different angles and of such thickness that they cannot be easily broken. One of these needles has a large curve to it to fit the curvature of the large lobes of the prostate; for the sides and the anterior angles he uses a shorter right-angled needle. The direction of the needle is guided by the two fingers which do not quit the bladder during the duration of the anesthesia. If the needle by mistake is stuck into the middle of the enlargement, the assistant who presses the piston encounters great resistance. If this happens the position of the needle should be changed, and when it is well placed the liquid penetrates easily. When the periphery of the prostate has been anesthetized, two punctures are made into the intraprostatic urethra to analgesize those regions where it is necessary to tear across the urethra.

A few minutes after the injection is ended operation can be proceeded with without pain.

Fig. 49.—Legueu's needles.

Allen follows Legueu's method in the work previously referred to except that he has no special needles constructed.

The illustration (Fig. 50) shows very clearly the methods of

both Allen and Legueu. There are two or three practical points which we have noticed which may be referred to in this connection. One is that it is necessary to have a finger in the rectum as well as two fingers of the other hand touching the prostate in the bladder

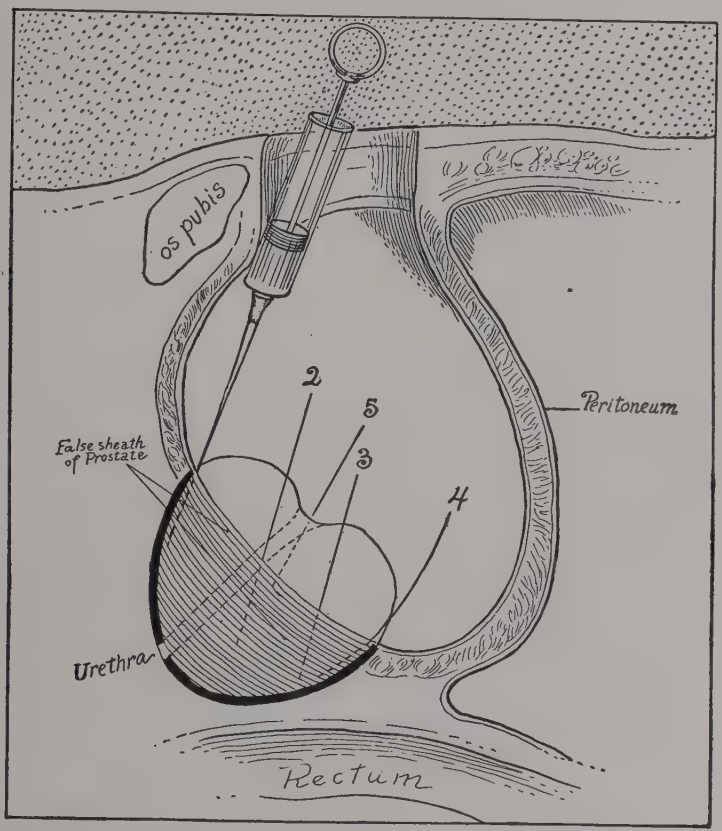


Fig. 50.—Local anesthesia for removal of the prostate (after Allen).

to prevent the danger of the needle being pushed through into the rectal wall. By doing this the needle, even if if it has to be pushed into the prostatic sheath to some extent by the assistant, can be guided in its direction. We have not noticed any great obstruction to the flow of the fluid even when the prostate itself has been penetrated by the needle. A very few minutes after injection of the fluid the prostate becomes absolutely insensible, and although the patient may complain and groan, it is very possible that it may be

due more to nerve shock than to actual pain. In making the original incision through the skin a small needle should be used to deaden the skin and cellular tissue, as its insertion causes less pain.

While we are inclined to strongly endorse and recommend the above procedure, it should not be forgotten that by whatever method such an operation as prostatectomy is performed, there is bound to be more or less after-shock to the system, and when required the application of hot-water bottles, the installation of the Murphy drip, or stimulants should be resorted to in a manner similar to what they would be if general anesthesia had been used.

As previously stated, operations on the scrotum, including castration and for circumcision, can be carried on by direct local injection anesthesia. For perineal section we have used direct local injection anesthesia with good results, which can, if desired, be supplemented by the parasacral infiltration methods of Braun.

Also concerning anesthesia in connection with operations on the genito-urinary organs the same general rules apply as to anesthesia for surgical operations on other portions of the body. It will be well constantly to bear in mind that ether and chloroform to a more or less extent have a poisonous effect upon the system, and particularly upon the kidneys, as has been abundantly proved by many investigators. One of the prime objects in the induction of all anesthesia is to do away with the reflexes. The more *confidence* can be inspired in the patient the less amouut of anesthesia will be required to overcome these reflexes.

Not infrequently it will be found wiser, on account of the mental effect, to apply as few preliminary dressings as possible to the individual before placing him on the table. Ordinarily, in patients with good courage, the anesthetic had better be administered in the operating-room, and as short a time as possible should elapse before the operation is commenced.

Quite a large proportion of patients requiring operation on the genito-urinary system are individuals in advanced years. *Cerebral hemorrhage* not infrequently follows immediately after or within a few months of such an operation as prostatectomy. As has been noticed by Albarran, the blood-pressure is a good index in many cases of the condition of the arteries, and it is ordinarily inadvisable to operate on the kidneys or prostate of an

individual with a blood-pressure of over 220 until at least an attempt has been made to reduce the pressure by appropriate treatment several days previous to the operation. For this purpose physical rest together with the application of such curative therapeutic remedies as may be indicated is advised. It should be remembered, however, that a high blood-pressure is often to a considerable extent compensatory.

Following severe operations on the genito-urinary tract little can be done to aid in overcoming the nausea following the anesthesia. The use of a hypodermic of morphin is suggested when pain requires its administration. The early administration of hot liquids in considerable quantities is highly recommended not only for its effect in washing out the stomach, but with the idea of early stimulation of the secretory powers of the skin, so as to relieve to some extent the work required to be done by the kidney. Herb teas of various kinds have been found useful for this purpose. A hot infusion of dried violet flowers has been long used for this purpose by one of us, and also infusions of dog grass and uva ursi will be found useful. When pain does not require the administration of morphin the fluidextract of passaflora and the use of ignatia has been found by us more useful in controlling any nervous symptoms that may exist than the more frequently used hypnotics or strong nerve sedatives.

Sometimes a better result is obtained in placing the patient recovering consciousness behind a screen, the attendant observing the patient from time to time from the top of it, rather than sitting by the bedside. There is less apt to be vomiting and nausea on account of the increased mental calmness.

The custom in severe operations on the urinary tract to administer for several days previous to the operation large quantities of water with or without one of the ordinary antiseptics, like salol or urotropin, is ordinarily to be recommended.

Following operations *pneumonia* is to be seen in two forms. One form comes on immediately after, within twenty-four to forty-eight hours subsequent to the operation, and may be due to a profound septic condition of the patient at the time of the operation, or not infrequently is due to too much exposure to cold or wet while under the anesthesia. The other form of pneumonia

is apt to follow a week or ten days subsequent to operation, particularly in elderly people. This is probably not infrequently due to carelessness connected with the nursing, through which patients have become exposed to draughts.

Following severe operations on the urinary tract there is generally some diminution in the quantity of urine passed through the first twenty-four to forty-eight hours. If this continues the flow of urine should be stimulated by the use of diuretics or such other medical treatment which seem to be indicated for the exigencies of the individual case. For anuria, or the complete suppression of urine, hot compresses or a poultice of digitalis leaves should be applied to the lumbar region. Subcutaneous injection of saline solution together with the use of high salt enemas is also recommended, and in desperate cases nephrotomy or drainage of the kidney pelvis while the symptoms of intoxication last. As a preventive of anuria following operation proctoclysis by the Murphy drip is of high value. Through this method 20 to 200 drops a minute of a saline solution are allowed to flow into the rectum at very slight pressure; a uniform temperature of the fluid in the rectum of 100° F. is desirable. To obtain this uniform temperature it is necessary to regulate the temperature of the fluid in the container to the rapidity of the flow; 160° F. is required for the fluid in the retainer if a flow of 20 drops a minute at the right temperature in the rectum is desired. A temperature of 138° to 140° F. in the container for a flow of 200 drops a minute. These figures are taken from a table prepared by Dr. R. C. Kemp of New York. Two factors deserve attention, one is to keep the fluid in the container at as even a temperature as possible; the other that the rectal tube should not be removed for a half hour or more after the container has become empty, so as to prevent the escape of several ounces of fluid which otherwise the rectum is liable to contain. The rectal tube should be introduced about 30 inches, and a pint to a quart of the solution used in one application.

The practice of permitting elderly patients to sit up in bed on the second or third day following such operations as prostatectomy, as has been advocated by many, is, in our experience, sometimes unwise. The idea in so doing is to overcome pulmo-

nary congestion, but generally elderly feeble people do better if no marked change in position is insisted upon from five days to a week following the operative procedure

Concerning the use of alcohol and tobacco following operations, particularly in elderly people, their administration should be regulated to a considerable extent by the previous habits of the individual operated upon. It is a mistake to attempt to change the habit of many years following severe operative procedures, and in such cases the early use of alcohol and tobacco should be permitted.

The most important positive factor to always have in mind in operations on the urinary tract of the elderly is *drainage*. The two important negative factors is to prevent *pneumonia* and *cerebral hemorrhage*, both of which topics have already been discussed, but concerning the question of drainage something more remains to be said. It should be considered not only after operation, but before. Ordinarily the ingestion of plenty of fluid

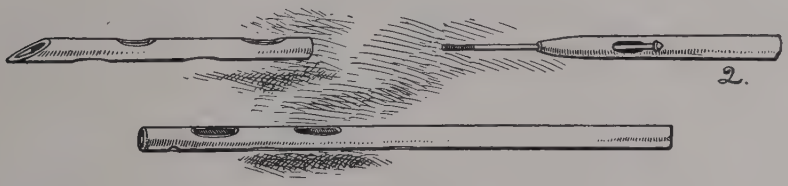


Fig. 51.—Retention ureter catheters for drainage of the pelvis of the kidney: 2, Conical lower end fitting closely to a small sound as guide (Albarran).

to wash out the kidneys is wise. In cases of infection of its pelvis, when practical, previous lavage through a ureter catheter with some fluid, as nitrate of silver 1 : 10,000, may put the kidney in a better state for the operation, if performed daily for a week before operating. While the drainage of the bladder for a week previous to many operations upon it or the prostate, through such a procedure as a retention catheter, not only tends to the improvement of the organ to be operated on, but thorough drainage of the kidneys tends to do away with any products of urinary absorption which may have accumulated and diminishes the danger of urinary suppression following it.

The proper after-drainage following operations on the kidney is of the greatest importance. The presence for some days when

possible of counter-drainage through a retention ureter catheter may be mentioned. Also the care when doing nephrotomy for kidney abscess, in thoroughly cleaning out the pockets of pus that may be present, will have much to do to ensure complete healing and prevent the formation of fistula. The after-results following such an operation as prostatectomy are dependent to a great extent on the proper drainage, while primary union may follow a cystotomy where the urine is clear if proper drainage can be obtained through a retention catheter.

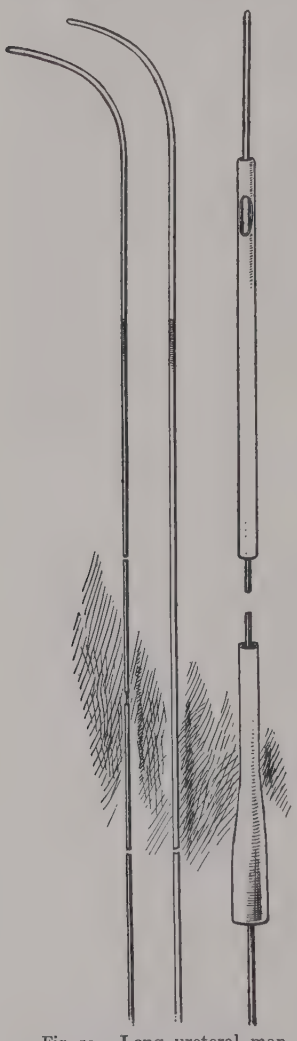


Fig. 52.—Long ureteral mandarin formed of two pieces which articulate. Used in changing ureteral drainage catheter (Albarran).

Our personal experience and that of our associates with retention ureteral or urethral catheters does not confirm the good results reported as obtained through their use abroad, and we have not been able to use very large ones for the ureter, or to keep them in for longer than thirty-six hours at a time on account of incrustation, while in the urethra we often have to remove them on account of irritation. This latter, we believe, is due frequently to the poor general condition of our hospital patients, but through increased familiarity with these two mentioned procedures on the part of surgeons it can be expected that their application can be made more frequent, and that they will greatly aid in obtaining better after-results.

Albarran uses ordinarily a No. 6 ureter catheter to commence with, as a guide during his operations on the ureter or the kidney. It is his custom to insert into the upper end of this ureter catheter, which has been introduced through the meatus of the urethra to the pelvis

of the kidney (or in case of an operation upon the ureter, through such an opening in the ureter as may have been made), a No. 12 ureter catheter; then, by withdrawing the No. 6 through the urethra, the No. 12 follows it along the urinary canal until its end emerges from the urethral orifice. It is sometimes allowed to remain as a kidney or ureter drain for a period as long as six days without removal. Should he find it desirable to change the catheter during that period, he does so by means of a mandarin in two parts, which is introduced into the retention ureter catheter, and over which a new ureter catheter is inserted, the new one following the one already in place from its superior insertion downward as the latter is removed.

Continuous bladder irrigation has been used to some slight extent with good results for cystitis and is used by some operators following prostatectomy. Although it has not yet come into general use, we believe it will in the future prove a valuable aid. It can be applied through a double-current catheter, either through a perineal or suprapubic opening.

CHAPTER IV

EXAMINATION OF THE URINE AND URETHRAL EXUDATE

EXAMINATION OF THE URINE

The technic of urinary examination is now so fully discussed in numerous special text-books that, with the limited space at our disposal, it seems unnecessary to consider this subject in detail; our attention will, therefore, be devoted, instead, to a consideration of the value and application of urinary diagnosis.

There is, perhaps, no field of diagnosis in renal disease in which greater error may result than from the making of isolated urinary examinations, though they may seem to afford the most accurate and direct evidence as to the action of the kidneys. This possibility of error is largely the result of the fact that not only does the normal constitution of the urine vary markedly in different subjects, but it may vary also in the same subject under many differing physiologic as well as pathologic states. The urinary characteristics are also very largely and directly dependent upon the nature of the food and drink, a fact that is too frequently overlooked in estimating the significance of any urinary examination. Finally, it should not be forgotten that a diagnosis should never be based solely on the urinary findings, and that these findings are to be looked upon only as symptoms and considered with all the clinical aspects of the case. It must not, moreover, be overlooked that just as marked variation exists in the urinary picture as in any other of the symptomatic manifestations of diseases of the urinary passages.

Collection of Specimen.—It is best, whenever practicable, for the physician to secure the specimen himself, receiving the same in a clean vessel, and, when desired for bacteriologic examination, under sterile precautions. Very serious errors in diagnosis and in subsequent treatment have followed a lack of attention to these manifestly important details. Unusual foreign substances in the urine should always be looked upon as contaminations until they can definitely be shown to have actually been voided by the patient. When considerable importance is to be attached to the

urinary analysis, a statement of the patient's diet and medication should be furnished with the specimen. In every case the specimen selected for examination should, if possible, be taken from the entire twenty-four-hour urine, the totaly quantity of which should further, of course, have been determined.

When considerable time must elapse between the collection of the specimen and the examination, the urine should be kept in the ice-box or a few grains of chloral should be placed in it. Chloroform or formalin may also be added for the same purpose.

Amount.—The amount of urine passed should always be considered in conjunction with the quantity of liquid nourishment taken and also with the water excreted by the bowels and skin. Only when these factors have been considered may the quantity of urine passed be regarded as a means of pointing out possible disease. In important cases a fluid and urine chart is very useful, since it graphically demonstrates any gross retention and at the same time is a most excellent control of the effects of treatment in local or general edemas. The amount of urine may vary normally between 800 c.c. and 3000 c.c. in twenty-four hours, this being dependent somewhat on the sex and the body weight; a fair statement of the average amount would be about 1500 c.c. Pathologic *polyuria* occurs in diabetes, both with and without glycosuria, and in interstitial nephritis. A temporary polyuria is a frequent accompaniment of many nervous and mental disorders, of shock, and of like conditions.

Decrease in the amount of urine is found in practically all conditions where blood pressure is lowered, as, for example, in various types of cardiac insufficiency. It is a very marked symptom of acute nephritis, where it may amount to actual suppression, and it is also seen in many nervous conditions, as in some cases of hysteria, epilepsy, and the like. As has been stated, it is of the greatest importance always to consider the quantity of urine excreted in connection with the amount of liquid ingested and that excreted by other emunctory organs.

Specific Gravity.—The specific gravity of urine is very closely associated with the amount excreted and with the total solids thus thrown out of the body. It may, therefore, be taken more or less accurately as a measure of the solids excreted. In order that conclusive data as to the excretion of solids may be drawn

from an examination of the urine, by any method, it is absolutely necessary that the entire twenty-four hours' amount be collected and the specific gravity determined from this.

Reaction.—The reaction of the urine is normally acid. It may, however, become amphoteric, neutral, or alkaline under the influence of medication, from the use of certain foods, and under some physiologic as well as in many pathologic conditions. In itself the reaction of any individual specimen has but little importance. When, however, the reaction of the fresh entire twenty-four hours' specimen is altered, the cause for this change must be ascertained. For example, after severe nervous strain, especially if prolonged, the urine may become intensely acid, due to excessive excretion of acid phosphates. A diet almost purely vegetarian leads, in many cases, to the excretion of an amphoteric or alkaline urine, whereas a diet rich in animal food, as a rule, gives rise to a highly acid urine. Frequently the reaction of the urine may cause more or less marked disturbances. Thus a highly acid urine may account for vesical irritation and for frequent and painful urination. Less often a strongly alkaline urine may cause similar manifestations. Where the reaction of the urine only is at fault, the condition is usually easily corrected by giving attention to the diet, fluid intake, or by simple corrective medication.

Urinary Constituents

Urea.—The amount of urea present in the urinary output should be determined as a matter of routine in all urinary examinations, for this substance is the most important element given off as a result of nitrogenous decomposition in the human body. Unfortunately, the amount of urea excreted under various physiologic as well as pathologic states varies, being largely associated with the amount of nitrogen thrown out in the form of other nitrogenous compounds, such as uric acid, kreatinin, xanthin bases, and the like; the total nitrogenous metabolism of the body can therefore be accurately estimated only when the presence of all these are determined, as by the method of Kjeldahl. For comparative clinical use the methods of urea determination as obtained by the Doremus or the Einhorn ureometer are sufficiently accurate in most cases. The amount of nitrogen ingested and the relative amount excreted with the feces must be taken into consideration. Tissue destruction resulting in increased urea excretion can be ascertained

only when comparison of the amount of urea excreted is found to be in excess of the relative amount of chlorids in the urine, for in health the chlorids equal about one-half the amount of urea excreted.

Nearly all febrile conditions, and whenever excessive tissue waste is taking place, are accompanied by an increase in urea excretion. Urea is diminished in such diseases as acute yellow atrophy, Weil's disease, and in other conditions where serious destruction of the liver parenchyma is taking place, under which circumstances ammonia compounds appear in relatively excessive amounts.

Uric Acid.—Uric acid occurs in the urine only as a result of the destruction of the nucleins of the food or of the body. There can be but little doubt that the amount of uric acid found in the urine has but slight clinical significance in most cases, except when due to the high acidity of the urine or to some other cause, it is precipitated in the form of fine crystals that, acting as foreign bodies, may give rise to marked local irritation. The amount of uric acid found in this form is, however, no measure of the quantity excreted, for crystals may be found abundantly even when little or no uric acid remains in solution, whereas, on the other hand, no crystals may be found in the urinary sediment when the acid may be present in large amounts held in solution. It is normally present in relation to urea in a ratio of about 1 : 60.

A relationship between numerous clinical manifestations that are commonly known as the uric acid diathesis and actual uric acid excretion has never been satisfactorily established.

Chlorids.—Under normal conditions the chlorids of the urine are a measure of the chlorids present in the food ingested; they occur mostly in the form of sodium chlorid. They are diminished in practically all acute febrile conditions, particularly in lobar pneumonia and in many forms of nephritic diseases where the amount of water excreted is also diminished, for it has been shown that the amount of chlorids thrown off bears some relation to the excretion of water; hence the importance of restricting the intake of sodium chlorid in nephritic diseases. The estimation of the amount of chlorids in the urine forms a fairly accurate estimate of the digestive and absorptive powers in any given instance. It should be remembered that in some cases of nephritis chlorid excretion is greatly retarded.

In purely clinical studies an accurate estimation of the chlorids

is rarely essential, and a fairly satisfactory comparative method is that afforded by adding a certain number of drops of silver nitrate to a definite amount of urine, and observing the character and density of the precipitate of silver chlorid that forms.

Phosphorus.—The presence of phosphoric acid in the urine, like the chlorids, is also dependent in considerable degree on the quantity of this substance taken in as food, only a small amount being the result of tissue destruction. This view does not, however, meet with universal acceptance. Phosphorus is found chiefly in the form of salts of sodium, potassium, calcium, and magnesium, and it is chiefly these substances that give the acid reaction to normal urine.

The excretion of phosphorus is diminished in most febrile diseases, and the decrease is more or less dependent on the severity of the disease. It is a matter of common clinical observation that severe nervous conditions are generally associated with an increased output; in leukemia the excretion is also, as a rule, greatly augmented.

The detection and determination of phosphates in the urine are possible only by the usual qualitative and quantitative chemic tests.

Sulphur.—The sulphur found in the urine is the result of the breaking down of albuminous substances in the body, only a small amount being accounted for by the inorganic salts of sulphuric acid taken in the food. The greater amount exists in the form of inorganic salts, known as *preformed sulphates;* whereas the remainder occur as combinations of sulphur and certain aromatic bodies and are designated as *conjugate sulphates.*

The sulphur compounds are normally found increased when tissue decomposition is taking place, and the conjugate sulphates are increased particularly when intestinal fermentation is going on. Certain drugs, such as morphin, the bromids, and the salicylates, cause an increased elimination of sulphur, whereas ingestion of alcohol results in a diminution.

Both qualitative and quantitative determinations of the sulphur compounds of the urine depend on the precipitation of barium sulphate; when a properly prepared solution of barium chlorid is added to the urine, the sulphur is deposited in the form of barium sulphate and the precipitate is then weighed.

Albumin.—The presence of albumin in the urine has long been regarded as indicating, for the most part, disease of the kidneys or vascular system; cases are, however, occasionally met in which

albumin appears to be excreted physiologically in the urine. This applies in a general way only to specific forms of albumin, such as egg-albumen or the albumin of other special articles of diet. From this it may be seen that the amount of albumin present in the urine may be definitely dependent on the character of the food ingested and on the condition of the absorptive and digestive functions. In nephritis, the amount of albumin excreted must not be taken as a measure of the progress of the disease, although this is very commonly believed to be the case. In certain forms of renal disease, particularly in those chiefly characterized by the production of scar tissue in the kidneys, the amount of albumin excreted is usually small, and therefore cannot, of course, be regarded as a measure of the gravity of the case. On the other hand, it will sometimes be found that a case presenting markedly favorable symptoms may yet persistently show large quantities of albumin in the urine. It must, therefore, be conceded that the finding of albumin in the urine has but slight value beyond that of aiding in diagnosis. Its disappearance in no way indicates that the disease is abating, nor does its persistence indicate further progress of the disease. An exception to this rule, however, must be made when the albumin present is found to be due to blood; then the quantity and fluctuation are often of great prognostic value.

The occurrence of special forms of albumin is often of considerable significance, and in obscure cases detailed chemic investigations will prove of marked service; thus the presence of Bence-Jones albumin is apparently definitely diagnostic of multiple myeloma, the chemic reactions determining its identity are simple and easily demonstrated.

As a rule, the Heller test, made with cold nitric acid, has been found one of the most satisfactory for the routine detection of albumin. When doubt exists as to its presence or absence, other tests should be employed, the potassium ferrocyanid test being one of the most delicate. For ordinary clinical purposes the quantitative determination of albumin can be made by the familiar Esbach method, which gives sufficiently accurate results.

Sugar.—This is often found in the urine of entirely normal persons under special dietetic conditions, as when sugar has been taken in abnormal quantities or when special forms of it, to which the individual's tissues seem to be intolerant, have been ingested.

The occurrence of lactose in the urine of pregnant or lactating women is very frequent. Apparently it has no serious significance. Certain special foods or drinks may also occasionally induce the appearance of sugar in the urine even though they contain no sugar in themselves. Thus, in a case under the observation of one of us, sugar appears whenever whisky or other concentrated alcoholics are taken, but does not occur in this instance after the ingestion of champagne or the sweet wines, nor even when sweets are taken in excess. When large quantities of certain forms of sugar have been taken and small quantities of it appear in the urine, this may in most cases be ignored as an indication of disease; it may, however, as pointed out by von Noorden, signify a lessened ability on the part of the tissues to burn up sugar, and an increased inclination toward the development of diabetes. The early detection of sugar, then, even when apparently of physiologic origin, often becomes a matter of considerable import in the preventive treatment of diabetes. For a more complete discussion of the appearance of sugar in the urine the reader is referred to the treatises dealing with diabetes.

Since there are a considerable number of substances that may give a reaction simulating the reduction tests with Fehling's solution, reliance should never be placed on this test alone,—at least in a preliminary examination,—but the fermentation test or that with phenylhydrazin, preferably the former, should also be employed. Quantitative tests are most satisfactorily made with Fehling's solution or with Whitney's reagent, the presence of other reducing bodies, of course, having first been disproved or removed.

Acetone.—Acetone should always be sought for in cases of glycosuria, although its occurrence is not limited strictly to this state. It is often found also in apparently purely physiologic conditions, although its presence is usually associated either with gastro-intestinal or hepatic disturbance or with true diabetes. The test that has been found most satisfactory for the detection of acetone is that of Lieben. (A few cubic centimeters of the first distillate of the urine are treated with several drops of dilute solution of iodopotassic iodid and sodium hydroxid, when, even if small quantities of acetone are present, a precipitation of iodoform occurs.) In cases of diabetes considerable amounts of acetone are of marked prognostic value and are generally of grave significance.

Indican.—Indican occurs in the urine chiefly when absorption from retained intestinal contents is taking place or when abnormal intestinal fermentation is going on; it is therefore seen in cases of constipation and in tyrotoxicon and other forms of ptomain poisoning. It is found in greater or smaller amounts in nearly all urines, and is of importance only when taken in consideration with other manifestations of abnormal intestinal absorption. It may be detected in the course of Heller's test for albumin, a variegated brown or purple line forming just above the acid zone. A more accurate test is made by shaking a few cubic centimeters of the suspected urine with a solution of ferric chlorid with hydrochloric acid, to which a small quantity of chloroform is added, which then, on separation, takes on the characteristic blue or purple color.

Bile-pigments.—Bile-pigments are usually found in the urine in cases of obstruction to the common duct, when hepatogenous pigmentation is present, or sometimes when extensive destruction of the blood is taking place. It is manifest chiefly in cases of jaundice due to any cause. In marked cases it is easily recognized by the deep color of the urine and by its power of staining filter-paper a typical bile color. It may also be detected by the addition of tincture of iodin in the form of a layer above the urine in a test-tube. If bilirubin is present, an emerald-green color will form at the point of contact. When nitric acid is added to the urine in a test-tube, as in the ordinary Heller's test for albumin, a color play, green predominating, will result.

Fat.—Fat never occurs normally in the urine. It is found, however, in cases of extensive destruction of the fatty tissues of the body, notably of the bone-marrow. It is occasionally seen after the administration of large quantities of fat either by the mouth or by inunction. The term *chyluria* is applied to a condition in which the fat present in the urine gives it a milky appearance. This condition is present most frequently in cases of filarial infection, though it may also occur when chyle enters the urine through fistulæ or in any other manner.

MICROSCOPIC EXAMINATION OF THE URINE

When possible, the urine should be thoroughly centrifugated before microscopic examination is undertaken. When a centrifuge is not at hand, the urine may be allowed to stand for a consid-

erable length of time in a conic sedimenting glass, after which the material collecting at the bottom may be pipeted off and examined.

The **urinary sediment** must always be considered in conjunction with the chemic characteristics of the urine; thus a highly acid urine may cause a precipitation of uric acid, even though this substance is present only in normal quantity. On the other hand, alkaline fermentation, which may take place entirely after the urine has been voided, may, unless this fact is known, lead to erroneous conclusions as to the conditions really present in the urinary tract.

It must always be remembered that the urine is very susceptible to contamination, which may be brought about either wilfully or by accident, and that foreign bodies of all kinds may be present in it—pus from the vaginal secretion, bits of lint from the clothing, or particles of many kinds derived from the dust and the air; they may also have been present in the vessel in which the specimen was received.

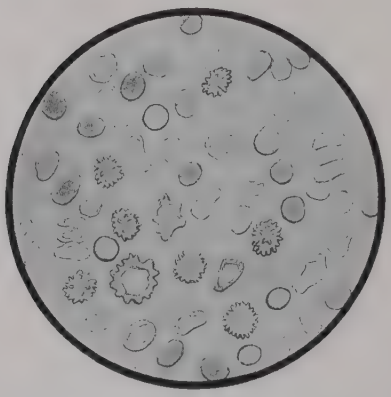


Fig. 53.—Red blood-corpuscles in urine (Jakob). The crenation shown by many of these cells is quite characteristic.

The microscopic examination of the urine must be considered along with, and not aside from, the general clinical manifestations of the case. It must never be lost sight of that microscopic diagnosis, just as all other forms of diagnosis, is open to error, and this is particularly likely to occur when conclusions too sweeping are attempted from mere microscopic examination.

Organized Deposits

Red blood-corpuscles are found in the urine whenever hemorrhage from any cause is taking place from any portion of the urinary tract. The source of the blood can be traced quite accurately, as a rule, from the clinical history or manifestations, by the presence of other tissue, as bits of papillomatous tumors or necrotic tubercles in the urine, which may, from their association,

indicate the probable nature and source of the hemorrhage. The quantity of blood present is, of course, a matter of considerable importance; when bright red and fresh in color, it is, for example, more likely to have originated from the urethra than from the upper tract.

Leukocytes or **pus-cells,** when they appear in the urine, are indicative of inflammatory or suppurative disease. As a rule, they are accompanied by the discharge of bits of tissue, such as flakes of epithelial cells or necrotic connective tissue which may, in a certain number of cases, indicate their probable origin. When associated with crystals, they may point to the possibility of calculus.

Mucus in considerable amounts is often found in the urine under normal conditions, particularly when the secretion of the seminal vesicles or prostate gland is present in large quantity. The presence of numerous shreds of mucus in the urine of the male is strongly indicative of an existing prostatitis. Mucus in large quantities is also generally found in cases of pelvic stone, and is then often mixed with more or less pus.

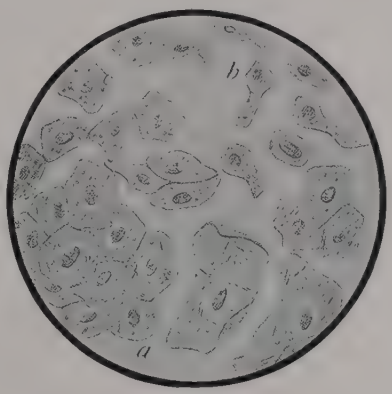


Fig. 54.—Squamous epithelium from urethra and bladder (Jakob).

The superficial layers of the bladder contain large squamous epithelial cells (*a*), the deeper layer club-shaped cells with tenuous extremities.

Epithelium.—Much has been written about the diagnostic possibilities of microscopic examination of the urine from the character of the epithelial cells found. A wide diversity of opinion exists as to the value of this procedure, and it is noteworthy that those who are least familiar with the normal histology of the mucosa of the genito-urinary tract are the firmest believers in its diagnostic importance. It should never be forgotten that the pelves of the kidney, ureter, bladder, and prostatic urethra are lined by a type of epithelium that is absolutely identical in all. A differentiation, even between masses of cells from these localities, is therefore impossible from the microscopic findings alone, and the clinician must form his decision as to the origin of the cells largely from other manifestations. Sometimes when cells occur in masses

those desquamated from the mucosa of the external genitals can be distinguished by their more squamous character from the typical "transitional" cells seen in the epithelium from the mucosa of the urinary tract proper. Cells from the renal tubules may also occasionally be differentiated from those of the lower layers of the transitional epithelium mainly by the parenchymatous character of the renal cells. A diagnosis should never be based on an examination of isolated cells.

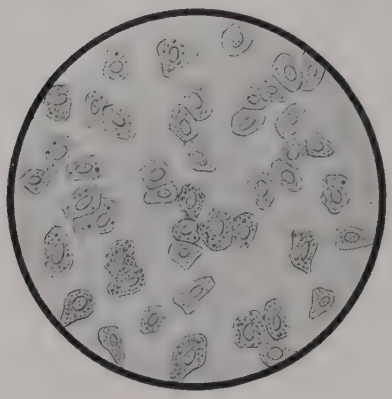


Fig. 55.—Renal epithelium (Jakob).

Fragments of tumors are occasionally found in the urine, and they may be of sufficient size to make a probable diagnosis possible. This should, however, be made very cautiously, unless the fragments are sufficiently large to permit of proper orientation

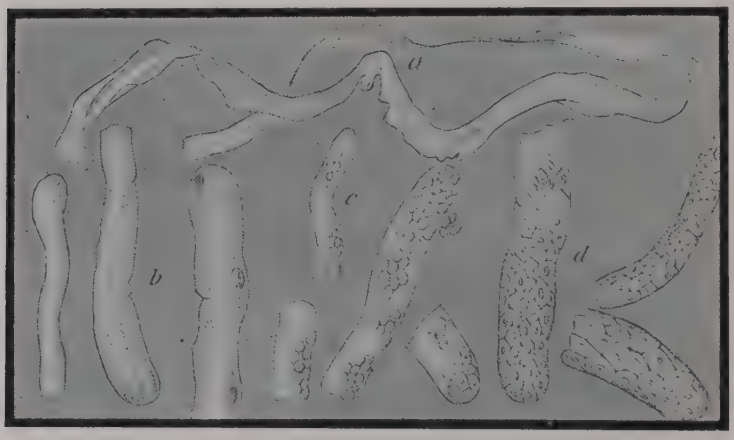


Fig. 56.—Urinary tube-casts (Jakob). In the upper portion of the figure are shown cylindroids (*a*), which are without significance. Below are hyaline tube-casts (*b*), which occur in conjunction with all diseases of the kidney (inflammation, stasis, irritation by toxins) in the form of narrow or broad cylinders. They occur as the result of a form of exudation into the uriniferous tubules. They are frequently the seat of white blood-corpuscles (*c*) or of renal epithelium (*d*). The latter relation is significant of profound disturbance.

and sectioning. Tubercular or gummatous involvement of the urinary tract may also occasionally be diagnosed from necrotic masses of tissue in the urine.

Spermatozoa or the secretion from the seminal vesicles, prostate, or other sexual glands may occasionally be found in the urine. Their value in diagnosis is dependent on the constancy of their appearance, and they can be considered as a determining factor only after a careful history of the case has been taken and their probable relationship or irrelavence to disease suggested.

Cylindroids are long, usually more or less convoluted, shreds of mucus, which are to be distinguished from true hyaline casts by the filamentous ends of the former. Their manner of formation is uncertain.

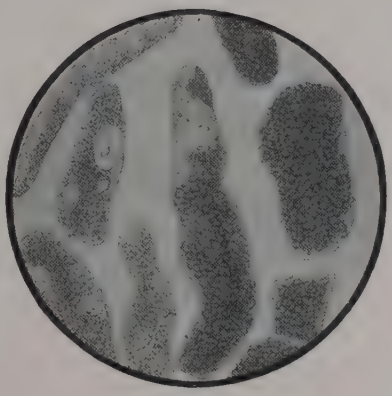


Fig. 57.—Coarsely and finely granular tube-casts (Jakob).

Casts.—The occurrence of casts in the urine is, as a rule, considered of too much importance in diagnosis, and is really valuable only when considered in conjunction with the entire aspect of the case. They are, however, a more certain index of renal disease than the presence of albumin. Thus they may appear in considerable numbers in the beginning of active diuresis, without indicating actual disease of the kidney. On the other hand, they are sometimes entirely absent in serious cases of nephritis. When they are present constantly in numbers they may be looked upon as probably the one most absolute diagnostic symptom of nephritic disease, although this disease may be confined exclusively to one kidney or even to a portion of one or both organs. The character of the casts is of much importance in this relation.

Fig. 58.—Waxy tube-casts (Jakob).

Hyaline casts are clear, transparent, narrow, though sometimes broad, cylindric bodies. They are, at times, found in practically all specimens of urine. When constantly present in considerable number, they are strongly indicative of nephritis, particularly of the diffuse interstitial variety. Their size depends on the caliber of the tube in which they are formed.

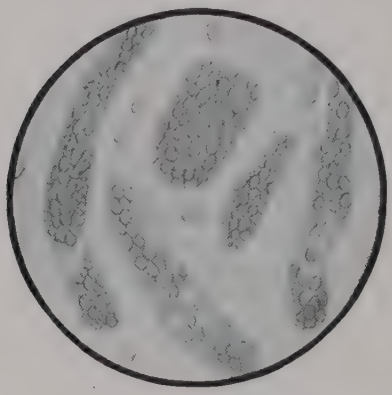


Fig. 59.—Blood-casts (Jakob).

Granular casts occur more constantly associated with disease of the renal parenchyma. Their granular character is probably the result of the detritus following parenchymatous degeneration and disintegration of the renal epithelium. They are classed as coarsely or finely granular or according to their size.

Epithelial casts appear in the urine when desquamation of the tubular epithelium is taking place. They consist of a hyaline cast to which epithelial cells are clinging in greater or less number.

Amyloid or *waxy casts*, which respond to microchemic reactions for amyloid, are found chiefly, though perhaps not exclusively, as the result of amyloid degeneration of the kidney.

Pus- and *blood-casts* are defined by their names, and are diagnostic of renal suppuration and hemorrhage respectively.

Fig. 60.—Fatty casts (Jakob).

Fatty casts are seen where fatty degeneration of marked degree is present, or in chyluria.

Crystalline Deposits in the Urine

It must be remembered primarily that the occurrence of crystalline deposits in a specimen presented for examination is by no means an unfailing indication that those substances are present in abnormal quantities, for unless they are passed as strictly abnormal substances, they may be precipitated as a result of the chemic characteristics of the urine, rather than as an evidence of oversaturation or from changes which have taken place in the urine after it has been voided. These substances are, for convenience of description, best considered under two headings—those found in acid and those present in alkaline urines.

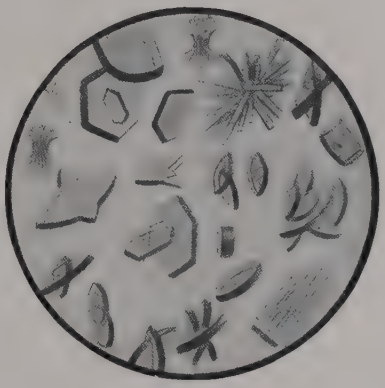


Fig. 61.—Uric acid crystals (Jakob).

Substances Found in Acid Urine.—One of the most frequent precipitates found in acid urine, particularly that of a highly acid character, is the familiar reddish or brick-colored deposit of *uric acid* or of the *urates of sodium or potassium.* Although their occurrence may not be strictly pathologic, they indicate a tendency toward the formation of uric-acid calculi, particularly when associated with certain colloidal substances. The variety of crystalline forms assumed by uric acid and its salts in the urinary deposit is large, and it must be remembered that these crystals are not always of the characteristic reddish color. (For a detailed description of the forms that uric acid may

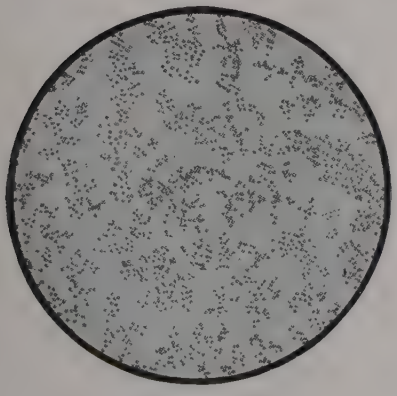


Fig. 62.—Sodium urate (Jakob).

take on, the reader is referred to the special works on urinary diagnosis.)

Calcium-oxalate crystals are one of the most frequent forms of urinary sediment. They are occasionally seen in urines that have undergone slight alkaline fermentation, although usually they occur only in acid urine. Macroscopically, calcium-oxalate appears as a hazy mucoid cloud settling slightly at the bottom of the receptacle. It occurs as the result of certain dietetic disorders or after the ingestion of certain foods, as rhubarb or asparagus, rich in oxalates. It is also quite constantly found associated with some forms of nervous disease, as neurasthenia, but the condition is chiefly important as pointing to the possibility of renal or cystic calculus formation.

Fig. 63.—Calcium-oxalate crystals (Jakob).

Cystin is a chemic substance rarely appearing in the urine. It occurs in the form of highly refractive six-sided plates. It is a product of proteid metabolism, and beyond the fact that it may form the nucleus of a calculus, is of slight clinical significance.

Leucin and *tyrosin* are crystalline substances the ultimate recognition of which must depend on chemic reactions. They occur in the urine as the result of serious metabolic disturbances of the liver, particularly in acute yellow atrophy.

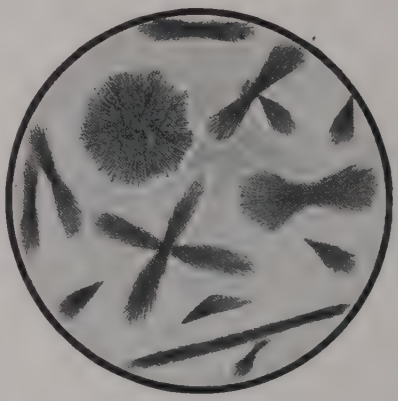


Fig. 64.—Tyrosin crystals (Jakob).

Large quantities of *amorphous phosphates* may occur in either acid or alkaline urine. They are found most abundantly in febrile

urine, after pronounced tissue destruction, when the phosphates of the urine are greatly increased as a result of the diet, and occasionally after severe mental or nervous disturbances.

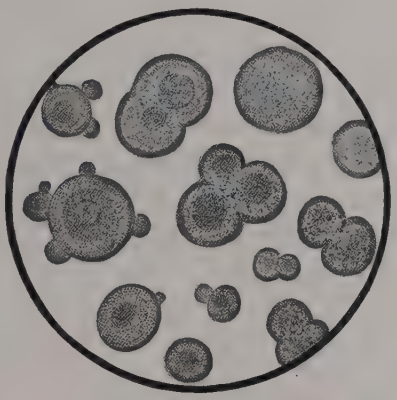


Fig. 65.—Leucin (Jakob).

Substances Found in Alkaline Urine.—The most frequent crystalline body that appears in alkaline urine is the familiar coffin-lid-shaped crystal of *ammonio-magnesium phosphate.* It may occur whenever alkaline fermentation is taking place, and though the crystals are commonly of the shape just mentioned, other forms are occasionally seen.

Calcium carbonate appears at times in the urine as large globular masses. Its clinical significance has not been definitely determined.

Ammonium urate occurs in alkaline urine under conditions similar to those under which the other salts of uric acid may be found, and not infrequently represents acid salts of uric acid in urines that have undergone alkaline fermentation.

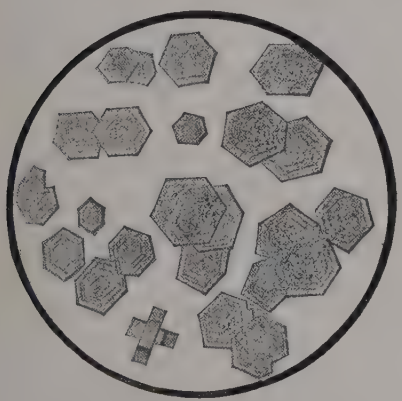


Fig. 66.—Crystals of cystin (Jakob).

Bacteria in the Urine

The most important of the bacteria commonly found in the urine are those that are concerned in the various infectious processes attacking the genito-urinary organs.

The **gonococcus** is, of course, found in cases of genito-urinary gonorrhea, its recognition, both clinically and microscopically, usually being easy. *Streptococci, staphylococci,* and *green-pus bacilli* occur more or less frequently as primary infecting organisms, or, more commonly, in the course of mixed infections, as in cases of gonorrheal or tubercular disease. The *proteus* and

colon bacilli are very frequently found in the more chronic inflammatory diseases of the genito-urinary tract.

As will be more fully discussed under the proper heading, the recognition of the **tubercle bacillus** in the urine is often a matter of considerable difficulty. Except when it occurs in large numbers, mere morphologic and microchemic reactions are neither positively nor negatively satisfactory, the findings in many cases requiring substantiation by animal inoculation, though by the use of the antiformin method much more certain and positive results are now possible (see p. 241). The recognition of the tubercle bacillus is particularly difficult because of its close similarity, in microchemic reactions, to certain forms of the *smegma* and *timothy hay bacilli*, which very commonly infest the genito-urinary secretion.

Fig. 67.—Ammoniomagnesium phosphate crystals (Jakob).

Actinomyces fungi are occasionally found in the urine, an indication, of course, that genito-urinary actinomycosis exists.

Echinococcus-hooklets are found in some cases of echinococcus cysts, and the embryos of the **filaria sanguinis hominis** are occasionally found in cases of chyluria due to filarial infection.

The **trichomonas vaginalis** and **cercomonas intestinalis** are occasionally seen, usually associated with chronic inflammatory diseases.

Still other micro-organisms appear in the urine from time to time in specific types of disease or accidental infections of the genito-urinary tract.

EXAMINATION OF THE URETHRAL EXUDATE

Whenever possible, the physician should himself collect the specimen for examination, for at this time the gross appearance, exact point of origin, odor, reaction, and the amount of discharge can best be ascertained. Oftentimes a brief history of the case will at once suggest the portion of the urinary tract that is the source

of the discharge; when the amount obtained for examination is small, the history will likewise determine the methods best calculated to demonstrate the points in question and no waste of material need follow.

Whenever the amount and character of the material permit, an examination should be made of the fresh specimen; this is done by placing a drop on a clean slide, and allowing a well-cleansed cover-glass to fall upon it, thus flattening it out sufficiently for microscopic study. Examination with a dry lens, a No. 6 or 7 Leitz, or DD Zeiss, will usually reveal the nature of the discharge.

In order to properly study a specimen it is necessary, in almost all cases, to eventually resort to staining methods. As a preliminary step in the preparation of such a specimen it is customary to spread the material over the surface of a clean slide. This is best effected by collecting the exudate in a drop near the end of a well-cleaned slide; a second slide is then approximated obliquely to this drop, causing it to spread along the whole line of contact; the upper slide is then drawn steadily across the first slide, spreading the exudate as a thin film over the greater part of the surface of the first slide. This process is the same as that usually employed in the making of a blood-slide. The specimen should then be allowed to dry in the air. The subsequent method of fixation to be employed is dependent entirely on the nature of the material, as determined from the gross and from the microscopic examination of the fresh specimen, and on the facts likely to be derived from microscopic study.

Purulent Discharges.—Acute purulent discharges are, as a rule, opaque, thick, and creamy. They spread easily and regularly under the pressure of the cover-glass, and are not uncommonly tinged with blood. The color is dependent largely on the character of the organisms present; thus when the pus is due to an infection with the staphylococcus pyogenes aureus, it is yellow or golden in color; when due to a white staphylococcus, it is light gray or white; when the green-pus bacillus is present, it is greenish in color. When large portions of the exudate are made up of mucus, as from uterine or prostatic discharges, this fact is at once manifest from the tenacious nature of the discharge and the difficulty with which it is spread on the slide.

In examining purulent discharges, the slide is best fixed by heating it on the copper plate or by holding it above the Bunsen or

alcohol-lamp flame until the surface becomes too hot to be held comfortably, but not until the upper or prepared side becomes browned, or the specimen is ruined. Slides may also be fixed by immersing the well-dried slide in a solution of chemically pure methyl-alcohol for from two to ten seconds; as a rule, however, heat fixation is more generally satisfactory.

After the slide has been fixed, the examiner selects the most suitable method of staining according to the points that are to be elucidated by the examination.

When but a general knowledge of the discharge and of the organisms present is desired, the best method, perhaps, is to stain the specimen with the familiar alkaline solution of methylene-blue known as Löffler's methylene-blue. The fixed slide may be immersed in a jar filled with this stain, or the stain may be dropped on the slide, the latter being gently heated over the flame to hasten the staining process. By this means bacteria and all chromatic elements are stained a deep blue, the nuclei of epithelial and connective-tissue cells being similarly stained; the cytoplasm is stained a lighter shade. If the specimen is stained too deeply, the excess of color may be removed by immersing in 70 per cent. alcohol for a few seconds. If desired, the slide may similarly be stained by one of the aqueous forms of polychrome methylene-blue, which gives a much wider color scheme to the elements of the specimen; in order to use this dye satisfactorily, however, the specimen must first have been fixed with methyl-alcohol. After the staining process has been completed, the slide may be dried rapidly by waving it to and fro in the air after first draining off the water in which it was washed, or it may be dried between two sheets of filter-paper, and placed for a minute in the hot oven, or it may be held above the Bunsen flame until it is entirely dry. The slide may then be examined with the oil lens, by simply allowing a drop of cedar oil to fall on the specimen where the lens is to be approximated. When it is desired to preserve the specimen for future reference or study, it is best, after drying, to cover it with Canada balsam or damar and place it under a cover-glass, after which the examination may be made. Specimens prepared in this manner are practically indestructible, whereas when no cover-glass is used, they soon begin to fade.

When the presence of tubercle bacilli is suspected, the slide

should first be stained with the usual carbol-fuchsin, which should be rendered more intense by the addition of heat until a vapor arises from the dye. The stain is then to be removed by first washing in water and then in 2 per cent. hydrochloric acid in a solution of 70 per cent. alcohol until the specimen becomes gray in color. The acid alcohol is next removed by washing in water, and the specimen may be counterstained by methylene-blue. If the tubercle, leprosy, or certain other special organisms are present, they appear as bright-red bodies, all the other tissues and bacteria being stained blue. When much pus, mucus, or other contaminating material is present in the sediment, it is best to add antiformin, so that it is digested away, leaving the tubercle bacilli much easier to detect. One must be particularly careful in drawing conclusions from this purely morphologic method. Very commonly the smegma bacillus, which is found abundantly about the genitals, is mistaken for the tubercle bacillus. Ordinarily, the smegma bacillus is decolorized by acid alcohol, but occasionally this is not the case; in order, therefore, to obtain absolute results in suspected tubercular disease the abdominal cavity of a guinea-pig should be inoculated with the exudate, and after a period of six weeks the animal should be killed. If the suspected material contained living tubercle bacilli, the peritoneum, liver, and spleen will be found studded with tubercles. This carbol-fuchsin staining method acts very satisfactorily not alone for the demonstration of the tubercle bacillus, but it also serves to demonstrate clearly the general character and bacterial content of simple exudates and may be well employed as a routine method.

Another important method of staining is that known as Gram's method; by means of this it is possible to differentiate bacteria that do not decolorize from those that do. The method is valuable chiefly in genito-urinary work for eliminating or identifying the gonococcus, which might otherwise be mistaken for the diplococcus catarrhalis or, in some cases, for the pneumococcus.

After heat fixation the specimen is to be stained with anilin water gentian-violet solution, and the excess of stain removed by rinsing in water, after which it is transferred to Gram's solution (iodin, 1 gm.; potassium iodid, 2 gm.; water, 300 c.c.). The specimen is allowed to remain in this solution for from one to two minutes, when it is removed and rinsed in 80 per cent. alcohol

until no trace of the violet color remains. For this purpose it may be necessary to return the specimen for a few minutes to the iodin solution. The preparation may then be counterstained, if desired, with Bismarck-brown, eosin, or some other contrasting dye. By this method "Gram-positive organisms," such as the ordinary cocci, retain the deep violet color, and "Gram-negative organisms," such as the gonococcus, take up the contrasting dye. Since, in this method, many technical errors are likely to occur, it is well first to place on the specimen, side by side with the suspected discharge, a pure culture of some well-known Gram-positive organism, such as the staphylococcus; by means of this control test it can be learned to a certainty whether or not the process has been managed correctly.

Simple Urethritis.—The exudate in simple or nonspecific urethritis often so closely resembles that seen in gonorrhea that it can be distinguished only by making a bacterial examination of the discharge. The amount of pus found in the specimen necessarily varies—when the infecting organisms are of an actively pyogenic character, the number of pus-cells is large; when, on the contrary, the organisms depart from this type, as, for example, in the case of the streptococcus, the specimen will be found to be made up largely of mucus and serum in which pus-cells naturally mingle, but are less abundant. As a rule, the pus-cells found are of the polynuclear neutrophilic variety, but small lymphocytes may be found, particularly in exudates of long standing, and sometimes in preponderating numbers. Eosinophilic pus-cells are occasionally seen, being not uncommonly present in the exudate of specific urethritis.

Epithelial cells are found in the discharge in greater or less number, being much more abundant in the more acute discharges. To a certain limited degree the character of the cells will point to the seat of greatest inflammation—thus, for example, when the process is limited chiefly to the fossa navicularis, squamous cells predominate; when to the penile urethra, columnar cells. When the process has been of long standing, as a rule epithelial cells, if found at all, are present in but very small numbers.

Red blood-cells may be found in small numbers in nearly all discharges, but as a matter of course they are most common in acute and active processes.

One of the most important points to be learned by the microscopic examination of the urethral discharge is that of ascertaining the bacterial content. In most cases staphylococci or streptococci will be found to be present; if the latter, the disease will generally be found to be an active one. Occasionally the diplococcus catarrhalis is present. This organism is distinguished with considerable difficulty from the gonococcus, and its recognition is often of great importance in questionable infections. It may be recognized chiefly by its great variability in size, its diminished tendency toward a diplococcus arrangement, and its less flattened surfaces where the pairs are opposed. It may be both intra- and extra-cellular. Further, it is not decolorized by Gram's method, and in doubtful cases it may readily be differentiated by cultural methods, for the diplococcus catarrhalis grows readily on ordinary media, whereas the gonococcus does not.

When the discharge is of long standing, as a rule, the bacterial content will be found mixed, bacilli of various forms being present. The colon and proteus groups are particularly likely to be seen in these exudates, and the discharge is generally of a highly mucoid or serous character.

When the preparations for examination are made as soon as the discharge is removed from the urethra, we are justified in attributing an etiologic significance to the bacteria demonstrated by an examination of the smear; in long-standing infections, however, it must be remembered that extensive mixing with contaminating, and very likely unimportant, organisms takes place. Cultures are important only when some special organism is sought or desired for purposes of identification, but they are often very misleading, inasmuch as the organisms that grow most actively on artificial media may have the least significance in the causation of the discharge.

The student should not be content with a single examination, particularly in long-standing urethritis, and it is often necessary to make several investigations under varying conditions before the true nature of the discharge will become evident. This is particularly true when gonorrhea is to be excluded, a matter to be discussed more fully further on.

Gonorrheal Urethritis.—The discharge in acute gonorrheal

urethritis is typically purulent in character. Pus-cells are very abundant; as a rule, they are of the polynuclear neutrophilic variety, but in some cases eosinophilic pus-cells appear to predominate. Epithelial cells are present in large numbers, particularly after the exudate has become well established, for at first the discharge appears only as a mucoid secretion in which a few pus-cells and desquamated epithelial cells are found. The cells seen in the early stages are chiefly of the squamous variety, and their origin is unquestionably in the fossa navicularis; later, as the penile portion of the urethra and the glands of Littré become involved, they become more rare and are chiefly of the columnar type. Both pus-cells and epithelial cells often show marked hydropic degeneration, and unless the specimen is prepared soon after the discharge is collected, such extensive necrosis may take place in all the structures found as greatly to lessen the accuracy and value of the examination. Mucus is present in moderate amounts; in the early stages, as has been mentioned, it may predominate, but in most cases the purulent elements are so abundant that the mucus is not evident. Blood-cells are almost constantly present in acute cases, especially when extensive infiltration of the urethral walls or of the urethral glands is taking place. When chordee is present, or when undue mechanic traumatism is inflicted, the amount of blood is found to be increased.

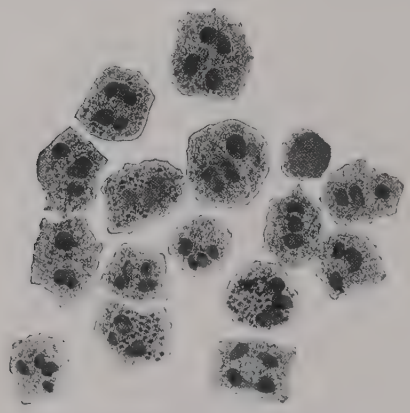


Fig. 68.—Gonorrheal exudate from a case of eight days' standing, showing presence of gonococci in pus-cells. Objective $\frac{1}{12}$ oil immersion, ocular No. 4.

The detection of the gonococcus is, of course, the most important finding to be elicited from a microscopic examination of the exudate. As a rule, gonococci appear in large numbers even in specimens collected in the very early stages, before the discharge has become markedly purulent; it is, therefore, possible to diag-

nose a gonorrheal urethritis before important clinical symptoms develop, by the detection of gonococci. In these very early cases the gonococci are found, for the greater part, free in the mucus that is present in the fossa navicularis, although they are generally found also in the cytoplasm of such pus-cells as may be present. As the exudate becomes more abundant and typically purulent, gonococci are found in very large numbers in both the mucous and the serous elements of the discharge and in the cytoplasm of the pus-cells, where they may appear in such enormous numbers as completely to obscure the nucleus and granulation of the cells. The morphology of the gonococcus is, fortunately, in itself sufficiently characteristic to permit of its recognition, in most cases, without special technical difficulties. This does not hold, as we shall see in the examination of the exudate in chronic gonorrheal urethritis.

The gonococci occur in the form of biscuit-shaped organisms. They are commonly found in pairs, the apposed portions of which show characteristic flattening. As a result of division, groups of four, eight, or more are seen, and occasionally masses are found that render recognition somewhat more difficult. As a rule, the "coffee-bean" shape is well preserved, and, even in atypical cases, the diplococcoid arrangement is evident.

In the early stages of most cases of acute gonorrhea, bacteria other than the gonococcus are absent or scanty, and even in those cases of some weeks' standing the number of gonococci so overwhelmingly exceeds that of any contaminating organism that little doubt as to the etiologic relationship to the clinical signs and as to the specific nature of the organism can exist. When, however, the original infection has been a highly mixed one, as when filthy conditions have been associated with the primary gonorrhea, other organisms may be present in such numbers as to render the making of a purely morphologic diagnosis somewhat difficult, besides altering the clinical aspects of the case. In these cases of acute gonorrhea it may become necessary to employ more complicated differential methods for the absolute identification of the gonococcus; ordinarily, however, specimens stained by the methylene-blue method give quite satisfactory results. Whenever any doubt exists or the disease must be viewed from a medicolegal standpoint, the specimens must be

stained by Gram's method; when this is done, the gonococci are decolorized and the other infecting cocci retain the gentian-violet color. This latter test, however, is not absolute, and when medico-legal identification is demanded, it may be necessary to resort to culture-methods; these require a considerable amount of technical skill, for the gonococcus grows sparsely even on the most carefully prepared artificial soil, and negative results, even in well-identified cases, are more frequent than positive. When the organisms grow on ordinary culture-media, it may be taken as positive evidence that they are not gonococci. As has already been stated, it is rarely necessary, for clinical purposes, to resort to these methods; it is usually quite sufficient to employ the ordinary methods for staining, followed, if any question arises, by Gram's method.

The exudate of chronic gonorrheal urethritis does not differ in appearance from that seen in simple chronic urethritis. Mixed infection is the rule, and in these long-standing cases it is often impossible to decide, from the examination of specimens, as to the relative etiologic significance of the bacteria shown to be present. Occasionally gonococci may still be found in considerable numbers, and no difficulty may be experienced in recognizing them. In other cases, where the discharge is of a distinctly gleety character, the most conscientious search may fail to reveal the presence of a single definite gonococcus. In cases of this nature, particularly when the subject contemplates marriage, repeated examinations should be made; in important cases it is well to excite a more or less acute inflammatory reaction in the urethra, since by these means the gonococci may occasionally reappear in recognizable form and numbers. It is to be remembered that in many of these chronic cases the organisms do not present their typical form. They are less diplococcoid in arrangement, the biscuit shape is less evident, and their size is often considerably reduced. In very many cases they are entirely unrecognizable morphologically, although, when inoculated on a normal mucous membrane, they readily set up a typical inflammation. In these cases, therefore, repeated examinations should be made and the preparations gone over by means of a mechanic stage; the specimens should also be taken under varying conditions. Cultural

methods are, in the opinion of the writers, of little or no assistance in these cases. In important clinical cases and in those which must be considered socially, it is best to consider the gonococcus as present until absolutely negative conclusions have shown it to be absent. In medicolegal cases, the opposite standpoint should be taken.

The Secretion in Prostatitis.—Although in by far the larger number of cases prostatitis is preceded by posterior urethritis, which ordinarily persists throughout the course of the disease, this is not invariably the case.

Acute prostatitis is, as a rule, accompanied by acute urethritis, and when this association occurs, the condition is readily recognized from the general clinical aspects, although the secretion may present but little that is of diagnostic importance. When the prostate becomes involved, shreds of mucus and mucopus formed in the prostatic acini and ducts generally appear in the urine; these may, however, become confused with similar bodies that are not uncommonly formed in the ducts of the glands of Littré. Corpora amylacea may also appear, but, as previously stated, it is most difficult definitely to determine, from the microscopic or gross examination of the exudate, whether or not invasion of the prostate has taken place. When bacteria appear in the shreds of mucopus it will, as a rule, be found that these organisms bear some etiologic relationship to the disease.

In the absence of urethritis, evidence of the existence of inflammatory disease of the prostate may be secured by first cleansing the urethra by urination or mechanic washing, and then, by massaging the prostate, forcing the secretion from its acini into the posterior urethra, from which, by voiding a small amount of urine, the specimen may be secured for examination. Conclusions must be carefully drawn from the examination of specimens obtained in this manner, for it must be remembered that the prostatic secretion so obtained normally contains elements that might erroneously be regarded as indicative of inflammatory disease. Thus, under normal conditions, there will be found leukocytes in considerable numbers; mucus, largely in the form of shreds; and corpora amylacea, with masses of isolated epithelial cells of the columnar variety. When, however, pus-cells are found in abun-

dance and blood occurs in more than minute quantities, and when bacteria are found to be present, disease of greater or less extent may safely be said to exist. Enough has already been said in regard to the examination of the urethral exudates concerning the character of these bacteria and the methods for demonstrating their presence, but mixed infections are not the rule. The examination of the prostatic secretion is particularly advised in cases of supposedly healed gonorrhea, for a few infected acini of the prostate gland, although quite sufficient to cause infection of another individual, may exist indefinitely without exciting symptoms that would attract the attention of the ordinary patient. No case of gonorrhea should be discharged as cured until such an examination has been made and no gonococci found.

Whenever pus is discharged from the prostate in considerable quantities, abscess of the gland is to be suspected, and in each case the character of the exudate should be thoroughly investigated. In simple inflammation of the prostate, as a rule, but little pus is present, and this is, for the most part, arranged in the shred-like mucoid masses previously described. When an abscess is present, the discharge of pus is much more abundant and may practically be continuous. In long-standing simple prostatitis, whatever its etiologic origin, members of the colon and proteus groups of bacteria are commonly present. Absolute identification of these organisms is possible only as the result of cultural experiments; this step is, however, rarely necessary for mere clinical purposes, since the morphologic and microchemic characteristics of these organisms are usually sufficient for their identification. When, however, tubercular disease is suspected, a special examination should be made. As has been stated, the absolute recognition of the tubercle bacillus is occasionally a matter of difficulty when staining methods alone are utilized, and it may be necessary to resort to animal inoculation, but, as a rule, the accompanying symptoms aid in the diagnosis. Thus, in tubercular prostatitis masses of necrotic tubercular tissue may be discharged from the gland into the urethra, from which canal they may be washed out by the urine and submitted to histologic examination, preferably by the antiformin method.

Vesiculitis.—The specimens intended for examination are to be obtained in a similar manner to those secured from the prostate,

except that after the urethra has been cleared, massage is to be applied over the seminal vesicles. Inflammatory disease of the seminal vesicles is a relatively frequent condition, and occurs as a complication of gonorrheal urethritis. The normal secretion of the seminal vesicles is composed of a mucoid material, desquamated cylindric epithelium, and may even contain a few corpora amylacea. In addition, spermatozoa in greater or less numbers can always be expelled from the seminal vesicles. When the specimen secured after massage is found to contain no spermatozoa, it is probably fair, in the adult, to assume that some obstruction of the vas on that side exists which prevents the escape of spermatozoa.

The methods of investigation of the exudate and the nature of the processes being similar to those that have just been discussed in regard to the prostate, no further description is necessary.

Cowperitis.—Although inflammation of Cowper's gland is a not uncommon complication of urethritis, and the body of the gland oftens remains, for a long time, a nidus of infection in which gonococci may persist indefinitely, it is impossible to obtain this secretion unmixed for purposes of examination, though where the duct remains permeable, the discharge doubtless escapes into the urethra.

Examination of the Seminal Secretion

Examination of the seminal secretion is not only of utility in diagnosing diseased conditions, but is useful also to determine the normal character, to establish the absence or presence of possible infecting organisms, to demonstrate the presence and viability of the spermatozoa, and in the conduct of certain medicolegal investigations.

In order to determine the viability and impregnating powers of the spermatozoa the examination should be made as soon as possible after the specimen has been obtained. These qualities are in part dependent on the motility of the spermatozoa, and while under the natural conditions of warmth and moisture in the genital tract, these bodies may remain motile for hours and probably for days or even weeks, when the specimen becomes cold, or when, through a process somewhat analogous to clot forma-

tion, changes in the chemic nature of the liquid take place, little can definitely be learned as to the vital character of the secretion. It is to be remembered that the mere recognition of seminal fluid as such is a very simple matter. Spermatozoa may be demonstrated in seminal stains months old on removal by washing in salt solution.

The seminal fluid is the combined secretion of several glands, and it must be borne in mind that foreign or disease elements may enter from any or all of these. As received in the vagina of the female, the seminal secretion is made up of spermatozoa and cells from the testicles, mucoid and serous secretion, with leukocytes and epithelial cells from the seminal vesicles and prostate mingled with Boettcher's crystals, mucus, and a few red blood-cells from ruptured capillaries from the glands of Cowper and from the numerous acini of Littré's glands. It must be borne in mind that even though viable spermatozoa are demonstrable in the secretion, this is not proof positive that they may impregnate any healthy ovum, for it has been shown definitely that certain serum affinities are also necessary for this to occur. It is quite possible for healthy spermatozoa to be destroyed in the tract of healthy females where these several affinities do not exist.

Normally, the fluid is alkaline in reaction, and gives off a peculiar and altogether characteristic odor. It produces a yellowish stain on white fabrics. Microscopically the fluid can be identified by demonstrating the presence of spermatozoa. This is determined most easily by simply placing a drop of the fresh secretion between a warm slide and cover-glass, when, in normal specimens, examination with a No. 6 or 7 lens will demonstrate the presence of spermatozoa in very great numbers. They will be seen to be actively motile, their serpentine mode of progression being very characteristic. Specimens may be spread on a slide, dried, and fixed by heat or by means of methyl-alcohol, formalin in 10 per cent. solution, alcohol, or other fixing reagents. Slides so prepared may then be stained with practically any of the chromatic dyes, of which methylene-blue, fuchsin, or gentian-violet are perhaps the best. When a sightly preparation is desired, the specimens may be stained by Boehmer's hematoxylin and counterstained by eosin.

Chemically, the secretion may be identified by the use of Flor-

ence's reagent (iodin, 2.54 gm.; potassium iodid, 1.63 gm.; distilled water, 30 c.c.). A drop of this reagent is added to the specimen, and the mixture is placed on a slide and examined under low power. Dark-brown crystals are formed, some of which are lance shaped and arranged in rosets, others being of a rhomboid or pyramidal shape. Old seminal stains also respond to this reaction.

In *spermatorrhea* the sediment of the urine contains spermatozoa, leukocytes, and mucus; these may readily be recognized by making a microscopic examination of the fresh specimen.

Constant absence of spermatozoa from the seminal secretion indicates either serious disease of the testicles or occlusion of the vas or some other portion of the channel. When the spermatozoa are found only in small numbers, this suggests obliteration of the passage on one side or perhaps faulty secretion. Malformed spermatozoa are seen in many general and local diseases of the testis. In excessive stimulation of the sexual function the spermatozoa are found in diminished numbers, the motility is less active, and many of the cells present exhibit defects of development. One of the most frequent of these, in the writers' experience, is a faulty development of the tail of the cell, which may be present only as a short, stump-like appendage. The head of the cell also presents many variations in these cases, one of the most common being that it has a spheric instead of an ovoid shape, and that it is, as a rule, considerably larger than normal; chromatic stains also show a lack of, or the presence of abnormal chromatic elements in this body.

Red blood-cells are found normally in greater or less numbers in the seminal secretion, but when inflammatory conditions are present in any portion of the genital tract, the amount of blood may become much increased—so much so, in fact, that it is readily seen with the naked eye.

Pus appears in the semen in suppurative disease of any portion of the tract, but is comparatively rare in actual suppurations of the testis, the lumen of the vas on the diseased side being commonly obliterated in these instances. For this reason it is rarely possible to diagnose the character of the testicular inflammation from an examination of the secretion, except when other portions of the genital tract are similarly involved. When, how-

ever, the secretion is found to contain pus or other abnormal elements, the tests previously mentioned should be applied, although positive results in most cases point to disease outside of the testicle.

Urorrhea.—In this condition, due to excessive activity of the urethral glands, the absence microscopically of any other elements renders the diagnosis easy, the secretion from the urethral glands consisting of long, slender, urethral threads of mucus, epithelium, and a few leukocytes.

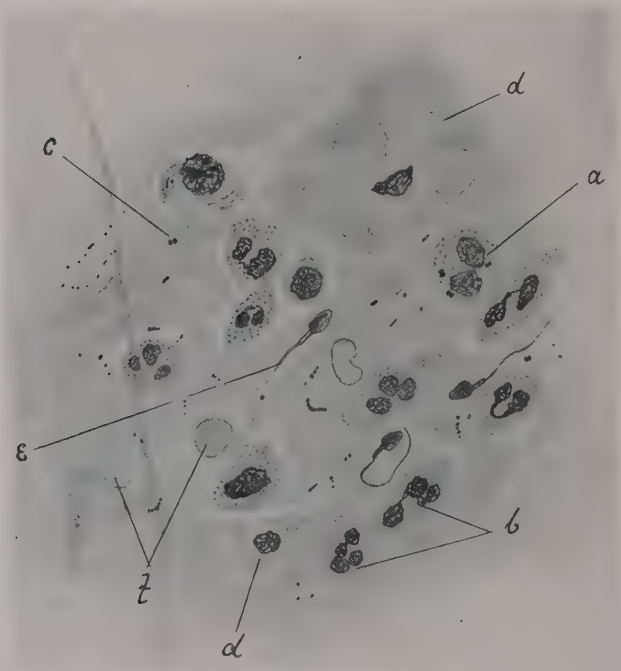


Fig. 69.—Smear from the vaginal discharge of a gonorrheal woman, shortly after coitus, showing the presence of pus-cells, desquamated vaginal epithelium, and spermatozoa. *a*, Pus-cells with gonococci; *b*, pus-cells without gonococci; *c*, gonococci in mucoid discharge; *d*, desquamated vaginal epithelium; *e*, spermatozoa; *f*, red blood-cells.

Examination of Secretions and Exudates from the Female Genitals

The examination of these secretions is of particular importance only in cases of suspected infectious disease. In these instances the examination must, in every instance, be very thoroughly

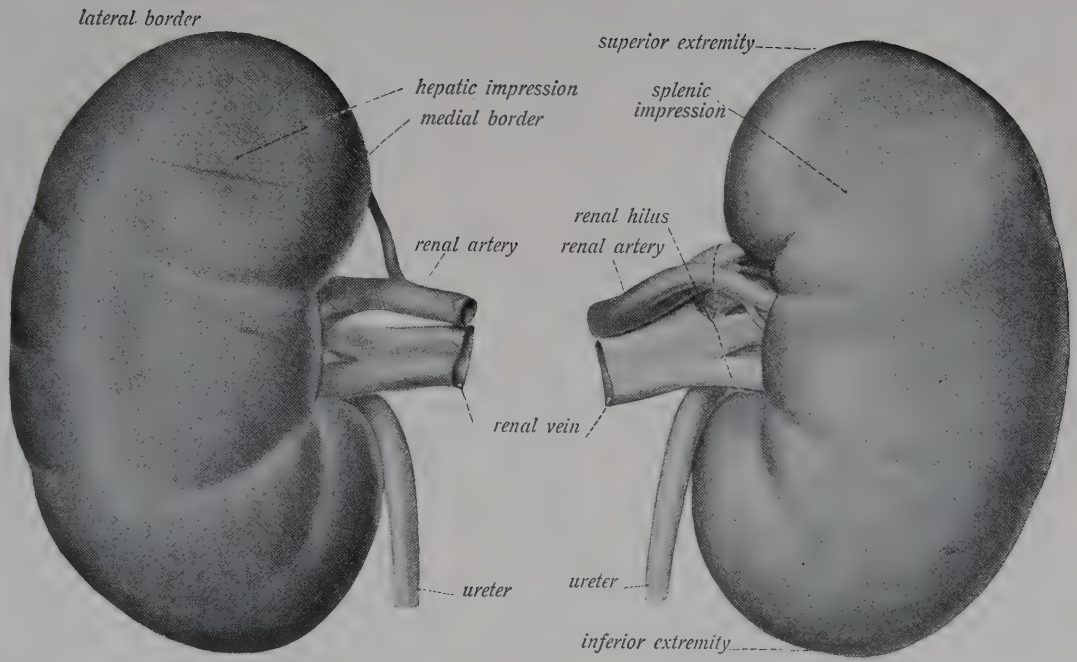


Fig. 1.—The right kidney seen from in front. Fig. 2.—The left kidney seen from in front. (Sobotta and McMurrich.)

made, and the physician must not content himself with examining a single specimen of exudate taken from any one portion of the vulva or vagina. In the case of suspected gonorrhea, particularly, the examination should be systematic, and should begin with exposure of the cervix uteri and inspection and microscopic examination of the *cervical secretion.* This is normally a clear mucoid material, resembling the white of an egg. Under many physiologic conditions, as just before, during, and after menstruation, this secretion becomes turbid from the presence of broken-down blood, leukocytes, and necrotic endometrium. When inflammatory disease of either the cervical glands or the endometrium is present, the cervical discharge becomes more or less turbid and white, yellowish, or green in color, according to the organisms present. Examination of smears of this discharge, as of the exudate of the male urethra, reveals the nature of the organisms involved in the process. Cervical gonorrhea is not frequent, except in acute cases or when a gonorrheal endometritis or salpingitis is present, when the secretion may trickle down from above.

Normally the *vaginal secretion* is small in amount, and consists chiefly of desquamated epithelial cells of the squamous variety and of serum and mucus. In inflammatory diseases there are added to these pus or leukocytes, and in active cases blood and such bacteria as are primarily or secondarily concerned in the process.

Diffuse gonorrheal vaginitis is rare, except in those cases of acute infection in which the process involves all portions of the tract.

The chief site of persistent chronic gonorrheal infection in the female is the vulvovaginal gland, and in all suspected cases the secretion should be expressed from these saccules and examined microscopically. It must be remembered, as was stated in considering the examination of chronic discharges in the male, that in chronic gonorrhea of the glands of Bartholin the gonococci do not at all times present typical forms, but involution types only may be seen.

In vulvitis the discharge from about the urethra should always be examined, as frequently the folds of mucosa about this orifice harbor infectious material. Similarly, the sebaceous secretion about the prepuce and clitoris should also be examined.

The small glands situated in either lip of the urethra should be particularly inspected, for they alone may be found infected.

In all cases it must be remembered that the secretion of the external female genitals may be said normally to harbor bacteria, but the organisms usually found here are, for the greater part, members of the putrefactive group, and have but little clinical significance. Infection and vulvitis caused by intestinal bacteria are obviously likely to take place, particularly where proper cleanliness of these parts is not observed.

Method of Procedure for the Complement-fixation in Gonorrhea.— The method is somewhat similar to the Wassermann technic, with the exception, of course, that the antigen employed is an extract of the gonococcus organism. Simple methods of extracting are employed, the most direct of which is the growing of gonococci of several strains on veal-ascitic-agar, salt free. The forty-eight-hour growth is washed off with sterile water and the emulsion is then autolysed in the ice-box for several hours or in a water-bath at 56° C. for two hours. This is then filtered through a Berkefeld filter and its antigenic properties are titrated. The reaction is usually done in $\frac{1}{10}$ or $\frac{1}{5}$ volume of that employed in the original Wassermann.

In *acute anterior gonorrhea* this test is of no value. In *posterior gonorrhea*, with its various local complications, it is more useful, and is generally considered accurate when positive, but negligible when negative. This test may be very valuable in the diagnosis of abscess or hidden cases of chronic infection, but must not be considered as accurate negatively. Generally speaking, the test will usually show whether a patient who has had gonorrhea is cured or not. A positive reaction may be considered as at least indicating that a man has had gonorrhea, but we are unprepared to assert that the reaction may not be sometimes given in clinically cured cases.

Examination for the Spirochæta Pallida

There can no longer be question as to the relationship between the spirochæta pallida of Hoffman and Schaudinn and syphilis. That this is the sole and essential organism concerned in the production of syphilis has not as yet perhaps been demonstrated absolutely theoretically, but clinically no doubt can now exist.

In order to demonstrate the presence of this organism a certain amount of technical skill is demanded, and negative findings cannot always be considered as of much import, since errors of technic are so frequent; practice, nevertheless, renders the technical difficulties fewer and more easily surmounted. Besides, the possibility of forming an early correct diagnosis is often well worth the time and trouble necessary for demonstrating the presence of the organism.

Although methods for the successful culture of this germ have been discovered, and animal inoculation is no longer especially different, it is usually necessary for us to rely chiefly on the morphologic aspects for diagnosis. These are at times misleading, for the germ may, unfortunately, be confused with other spirochetæ; by practice, however, the examiner will be enabled to readily exclude most of these organisms.

The mode in which the material is collected for examination is of the greatest importance, for unless great care is exercised to free the specimen from blood and pus, the demonstration of the spirillum is rendered more difficult.

The surface of the suspected primary or secondary lesion should be cleansed thoroughly from blood and exudate, and the investing epithelium should be carefully curetted away. A small drop of the exuding serum is then collected directly on the surface of a thoroughly clean slide, or it may be transferred to the slide by a sterile platinum loop—it is absolutely necessary that the smear be made as thin as possible. A drop of serum may also be secured from a suspected lymph-node by means of a hypodermatic needle and aspiration. The cover-glass preparation is then allowed to dry in dust-free air.

Several methods of staining have been successfully employed, but most of them, such as the method of Giemsa, by which the organism was first successfully demonstrated, are long and complicated. The writers have found the method of Goldhorn by far the most satisfactory. This consists in the use of Goldhorn's preparation of polychrome methylene-blue.[1] Other polychrome dyes may now also be similarly employed.

[1] The methods for preparing this were detailed in the "Journal of Experimental Medicine," March, 1906; also in less detail in the "N. Y. Post-Graduate," February, 1906.

A small amount of the dye is dropped on the specimen without previous fixation, and after two or four seconds it is poured off and the preparation slowly immersed in water. It is important, in doing this, to prevent the deposition of sediment on the specimen; the slide must hence be introduced into the water in a slanting direction, with the preparation side down; after a second or two the slide may be waved to and fro until it is free from stain, when it should be removed from the water and placed in a slanting position to drain. It is allowed to dry naturally, but it is important that the air of the room be free from dust, or the resulting specimen will be difficult to study.

The organism will be seen as a very faintly stained spirillum, characterized by its more or less sharp-pointed ends and by its acute angular flexures or turns. It varies in length from half that of a red corpuscle to as much as 25 microns. When stained in the manner directed, the germ is of a purplish-black color; it can be rendered a deep black by washing the stained specimen for from ten to fifteen seconds in Gram's iodin solution. The specimen is mounted and examined with an oil-immersion lens in the usual manner; a persistent search is often necessary to reveal the presence of the spirillum. Impregnation staining methods employing solutions of silver nitrate and subsequent exposure to light are now used with great success and supply us with a more simple means for the recognition of the organism. For examination of smear preparations, however, the polychrome dyes have as yet proved most accurate in our hands, but for section staining the silver nitrate methods are most satisfactory.

Dark field illumination, which requires, however, special but not excessively expensive apparatus, makes it possible to easily and quickly demonstrate the organism in fresh and unstained specimens.

The great diagnostic accuracy of the Wassermann and Noguchi serum reactions in all stages of syphilis have rendered search for spirochætæ somewhat less necessary than formerly. Still in the primary and secondary stages of the disease the demonstration of the organism is generally easier, quicker, and more definite.

CHAPTER V

THE KIDNEY: ITS EMBRYOLOGY, ANATOMY, AND PHYSIOLOGY

EMBRYOLOGY

In the development of the body the kidney is preceded by the formation of two kidney-like structures in the intermediate cell mass, the *pronephros* and the *mesonephros*, both of which originate from portions of the Wolffian body. These organs contain glomeruli and tubules, not unlike those subsequently seen in the true kidney, and open into the Wolffian duct. In the male the nephros later becomes atrophied, but persistent remains form the parovarium in the female, and parts of the epididymis in the male.

The anlage for the true kidney, or *metanephros*, appears during about the seventh week of intra-uterine life. Its mode of development is very similar to that of the Wolffian body, and it is similarly formed, chiefly in the intermediate cell-mass of the mesoderm. The tubules are shaped within this tissue, appearing first as blind sacculations in the formation of which the primitive peritoneum now appears to take no part. One extremity of each tube becomes dilated into a spheric body, into which capillaries grow, thus invaginating the walls of the spherule, and so forming the *Malpighian body* and the *capsule of Bowman.* Only the cortical portions of the kidneys are developed from the intermediate cell-mass in this manner. The pelvis, the medulla, and the ureters are formed from protrusions of the posterior extremity of the dilated Wolffian duct; these outgrowths pass toward the intermediate mass, and subsequently the tubules of the cortex unite with those that represent the conducting portions of the urinary passages, which are thus derived from entirely different structures. McMurrich states, however, that the entire renal tubule is derived from this outgrowth of the Wolffian duct, and that the intermediate cell-mass contributes only the supporting tissue and the blood-vessels.

The *glomeruli* appear at about the eighth week, and in the third month the papillæ are formed (Quain). At about the tenth week the surface of the kidney becomes lobulated. The further development and elaboration proceeds along the lines of simple growth.

ANATOMY

The kidneys are two bean-shaped organs, lying in the posterior portion of the abdominal cavity, outside the peritoneum, one being on each side of the spinal column, and on a level with the last dorsal and the upper two or three lumbar vertebræ. Usually the right kidney lies somewhat lower than the left, probably due to the pressure on this side exerted by the right lobe of the liver, the inferior surface of which frequently presents a depression corresponding to its point of application to the kidney.

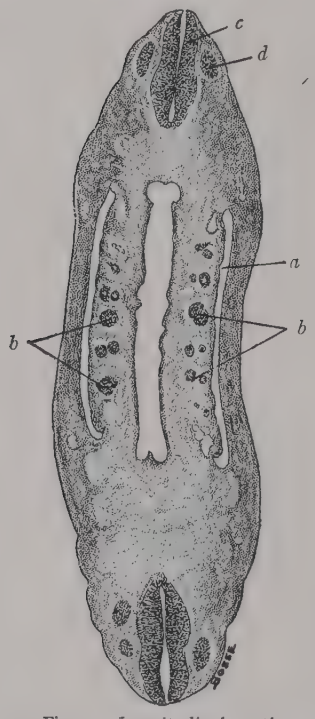


Fig. 70.—Longitudinal section of human fetus of twenty-six days' gestation, showing the pronephros or earliest anlage of renal tissue. *a*, Wolffian duct; *b*, *b*, developing glomeruli of pronephros; *c*, neural canal; *d*, posterior root ganglion. Authors' specimen.

The kidneys are so arranged in the abdominal cavity that their anterior surfaces are slightly everted, looking forward and outward, their posterior aspects being correspondingly arranged in the contrary planes. The normal kidney has an average size of about four inches in length; two and a half inches in breadth; and one and a quarter to one and a half in thickness (Quain); as a rule, however, the right kidney is somewhat longer and thinner than the left. The average weight is about four and one-half ounces, but both size and weight vary quite constantly, under normal conditions, with the body weight; thus the largest kidneys are generally seen in the largest bodies. Probably on account of this fairly definite relationship between body weight and the

size of the renal organs the average size of the kidney in the female is somewhat smaller than that of the male.

The kidneys lie posterior to the peritoneum; the anterior surfaces are directly covered by this membrane, except in stout subjects, where separation by a deposit of fat over the anterior surface of the kidneys often occurs in marked degree. The other aspects of the kidney are, in well-nourished subjects, embedded

Fig. 71.—Kidney from a human fetus of four months' gestation, indicating the differentiation in development between the cortex and medulla. Authors' specimen.

in a thick layer of adipose and areolar tissue, which serves to retain the organ in place and doubtless acts as a very efficient protective layer or insulator, particularly against sudden chills or trauma.

The surface of the adult human kidney is smooth and of a deep-red color. Not infrequently, however, it is seen to be more or less lobulated, simulating the kidneys of the fetus and certain of the lower animals.

Anteriorly, the left kidney region is crossed by the pancreas, and the splenic vessel lies just about at the level of the hilum. Above,

it lies behind a portion of the stomach and a few coils of small intestine.

The right kidney is situated posterior to a portion of the duodenum, whereas the ascending colon on the right side and the splenic flexure and descending colon on the left are found at the lower and outer parts of the right and left organs respectively. The upper portions of both kidneys are surmounted by the adrenal bodies.

When in their normal position, the kidneys cannot ordinarily be palpated in well-nourished subjects. In emaciated individuals or in those in whom the abdominal walls are very much relaxed, the kidneys may be felt on deep palpation, particularly when they have left their proper position and taken a lower one. Renal palpation, however, becomes easier as experience is gained.

The *blood-supply of the kidneys* is derived from the short and nearly straight renal arteries, which are given off directly from the aorta. As a result of this anatomic arrangement it will be seen that the kidneys receive a very direct blood-supply, and one in which the pressure is practically the same as that in the aorta. The large size of these arteries also insures an abundant blood-supply for these organs. The renal arteries are, however, somewhat protected from the direct systolic blow of the heart by a very thick and well-developed tunica media, the amount of blood entering them being also in part thus controlled. The blood is returned from the kidneys by the large renal veins, which enter directly into the inferior vena cava. In addition to this blood-supply the kidneys also receive a certain amount of blood through small vessels that penetrate the capsule from the surrounding areolar tissue, anastomosing with the terminals of the interlobular arterioles. A venous return also takes place along the same channels. Under normal conditions this additional blood-supply is relatively unimportant, but in some diseased states it may become of considerable value, serving at such times to nourish the organs and even perhaps to maintain a certain amount of renal excretion, as, for example, in thrombosis of the renal artery.

The *lymphatics of the kidney* are made up of a deep and a superficial set. Uniting with those of the adrenal bodies, they pass toward the median line along the course of the renal blood-vessels,

where they drain into a group of lymph-nodes that lie about those vessels and that are connected with the lumbar retroperitoneal lymph-nodes.

The *sensory nerve-supply of the kidneys* is probably derived from the tenth, eleventh, and twelfth dorsal spinal nerve-trunks, the fibers being transmitted through the sympathetic plexuses (Head). By far the more important nerve-supply for the kidney, however, is that which controls the vasomotor impulses; both constrictor and dilator fibers, according to Bayliss and Sterling, probably originate from the dorsal nerves from the sixth spinal segment downward. Constrictor fibers are also probably derived from the two upper lumbar trunks. All these fibers probably blend in the ganglia of the renal plexuses.

Structurally, the kidney is a highly modified compound tubular gland. Much of its finer construction, especially the gross distribution of the tissues that carry on the specialized functions of the organ, is apparent to the unaided eye. Anatomically, the viscus may readily be divided into the capsule, the cortex, the medulla, and the pelvis.

The *fibrous capsule* that incloses the kidney can, when the organ is normal, be separated from the cortex of that organ with but little difficulty. This capsule is loosely united to the surrounding adipose tissue in which the organs are embedded, and is made up of a fairly thin layer of mixed connective tissue and a thin stratum of smooth muscle that incloses the entire organ, being attached to the cortex by delicate strands of connective tissue that convey minute blood-vessels. At the hilum the capsule becomes continuous with the adventitia of the renal vessels.

The *cortex* is made up of a layer of dark-red tissue, about one-half inch in thickness, that surrounds the central portion of the organ except at the hilum, where it first becomes thin and then disappears. Projecting up into the cortex from the medulla are bands of striations that extend nearly, but not quite through, the cortical tissue; these, from their fascicular appearance, are known as the *medullary rays*. The remainder of the cortex is composed of the *labyrinth*, and it is in this portion of the kidney that its most important activities take place.

The *medulla of the kidney* is formed by the pyramids and the

columns of Bertini. The *pyramids* are masses of tissue that, to the unaided eye, show a coarse striation radiating from the bases, which lie against the cortex, toward the apex of the pyramid. When divided either longitudinally or transversely the pyramids resemble in appearance a miniature fan, the framework of which is represented by the radiating striations. The narrow tongues of striation, the medullary rays, which are continued into the cortex and which have just been described, are simply narrow prolongations of the pyramidal structure into the cortex. The *columns of Bertini* are strands of connective tissue that support the blood-vessels and lymphatics as they pass from the central portion of the kidney toward the cortex; to the naked eye they appear as continuations of the cortex, highly vascularized, dipping down between the pyramids.

The *pelvis of the kidney* is a large, funnel-shaped receptacle whose narrowest portion begins at the hilum, spreading out at its base into bay-like dilatations known as the *calices*, into which the papillæ of the pyramids open—usually only one, but two or three may open into the calyx. The pelvis is lined by a layer of transitional epithelium that is continued over the papillæ. It is supported by a basement membrane of connective tissue, over which is arranged a longitudinal and a circular stratum of smooth muscle—a continuation of the muscle layers of the ureter. The coats are completed by an outer fibrous sheath in the structure of which many yellow elastic fibers enter.

Microscopically, the greater bulk of the *renal tissue* is made up of long epithelial tubes (highly modified tubular glands) that secrete the urine and conduct it to the pelvis of the kidney. Every urinary tubule, it must be remembered, is not thus fully developed, for they vary greatly in length, many being quite short.

The *urinary tubule* begins in the labyrinth of the cortex as the *capsule of Bowman*, which is formed of the dilated and invaginated end of the tube. The cavity thus formed is occupied by a tuft of capillaries. The capsule of Bowman is lined down as far as the constriction, known as the neck, by a layer of thin simple squamous epithelium. The entire mass of capillaries and its epithelial envelop are known as the *Malpighian body*. Below the neck (a narrow straight passage lined by small cubical cells) the tubule

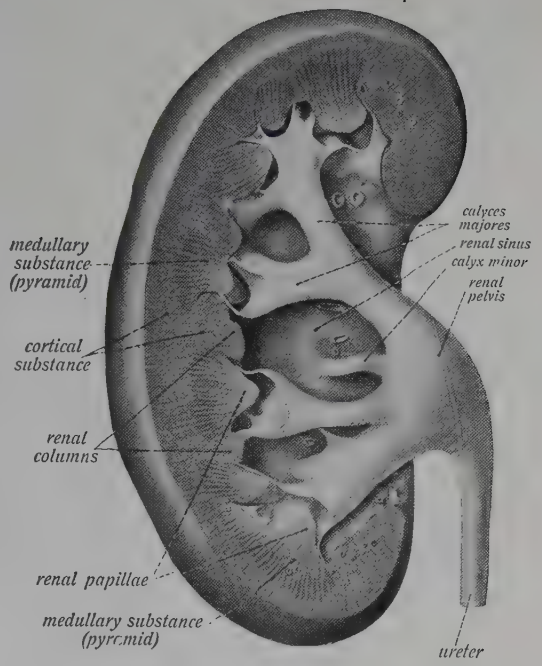


Fig. 1.—The renal pelvis and sinus laid open by a frontal section. The vessels and fat tissue of the sinus have been removed.

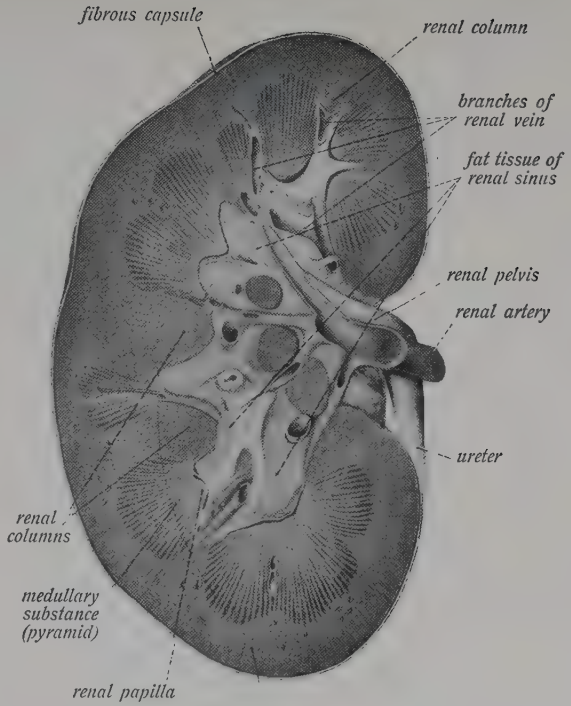


Fig. 2.—The kidney with its fibrous capsule divided by a frontal section.

(Sobotta and McMurrich.)

opens out into a wider channel, lined by larger cubical or columnar epithelium and thrown into many folds; this portion, which is still contained in the labyrinth, constitutes the *proximal convoluted tubule.* The tube then enters the medullary ray, passing downward toward the medulla in a tortuous manner, where it is known as the *spiral tube.* As it approaches the juncture of the cortex and the pyramid the tube suddenly narrows, its epithelium now being made up of flattened cells with larger nuclei; this portion constitutes what is known as the *descending limb of Henle.* After continuing downward for a certain distance within the pyramid the tube becomes larger, its epithelium cubical, and it curves on itself, forming the *loop of Henle;* it is then continued upward, being lined by cubical cells until it again passes, now as the *ascending limb of Henle,* into the cortex, as an irregular convoluted tube of larger lumen known as the *irregular tubule.* This channel leads directly into a tube precisely similar in structure to the first or proximal convoluted tubule, and known as the *distal* or *second convoluted tube.* This leads through the arched collecting tubule toward the medullary rays, where it empties into a tube of free lumen, lined by cubical epithelium, named the *collecting tubule.* The collecting tubules unite to form other and larger ducts, all continuing downward toward the urinary papilla, where they finally open out into the pelvis of the kidney.

The *minute anatomy of the blood-supply* of the kidney is of considerable importance for the correct understanding of renal disease. As the renal artery enters the hilum of the kidney it commonly breaks up into two or more smaller trunks, which pass, external to the sheath of the pelvis, toward the columns of Bertini, where they again form smaller trunks, at least one of which is continued up toward the cortex through the column. At the junction of cortex and medulla anastomosing lateral branches are given off, forming a series of vascular arches known as the *arterial arcade.* From these small branches, the *arteria rectæ,* which pass straight downward through the pyramids, supplying their nourishment, are given off. Another series of branches pass upward, where they are distributed to the tissues of the cortex. As the trunks course upward they give off lateral branches, which become smaller and smaller, finally terminating just beneath the capsule.

The lateral branches pass to the capsules of Bowman, which they enter, then break up into a complicated mass of anastomosing capillaries—the *glomerulus*. The entering arteriole is known as the *afferent artery*, and the blood, still arterial, is collected from the Malpighian bodies, leaving it in a separate arteriole, the *efferent artery*. The efferent artery then passes to the convoluted tubules, about which it breaks up into a very complicated capillary network. The blood from these capillaries is collected by a vein that empties into successively larger venules and veins, corresponding in name and location to the accompanying arteries, finally escaping from the kidney through the renal vein. The capillaries of the minute terminal arterioles that penetrate to the capsule nourish this structure and then return the blood by a corresponding venous tract. Occasionally, particularly under diseased conditions, these vesssels may anastomose with trunks penetrating from the areolar tissue surrounding the kidney; in this manner a secondary and distinctly separate blood-supply of the kidney is formed.

PHYSIOLOGY

The kidney is the chief excretory organ of the body. Although other organs, more especially the skin and bowel, are concerned in the work of excretion, experimental and clinical observation has demonstrated that the presence of renal tissue is necessary for the maintenance of life, and that a certain and quite definite amount of kidney substance must be present. Thus it has been shown that if an amount of kidney substance equal to three-fourths of the entire weight of the organs be removed, death follows. This occurs even though the amount of water, urea, and other urinary salts be increased, in partial extirpation of the kidney, and it may be taken as an indication that, in addition to its excretory function, the kidney is also concerned in some internal secretory process that is essential, in part at least, for the maintenance of life.

It was formerly believed that the kidney merely served as a filter for the blood of the body; repeated studies have, however, demonstrated beyond question that its function is far more com-

plicated, though governed in large degree, nevertheless, by the state of the blood-vessels, the pressure in them, and the amount and character of the circulating blood. Starling, of late, has in particular shown, both experimentally on animals and in man as well, that the kidney automatically adjusts its relative excretion to the momentary needs of the body. Thus, where water is introduced in overabundance, the excretion of water by the kidney is heightened, or if various salts become relatively too abundant, these bodies are automatically thrown out with greater relative rapidity. This vital adjustment of the kidney to the special needs of each individual has been most decisively demonstrated by Starling and his pupils.

Unquestionably, the greater part of the water and inorganic salts of the urine are excreted by the action of the Malpighian bodies. It is still an unsettled question as to whether the secretion of these constituents of the urine is entirely a mechanic process,—one of osmosis dependent solely on blood pressure, osmotic tension, and on the rapidity of the circulation,—or whether, in addition to this, the cells of the capsule of Bowman, and perhaps those of the capillary tuft also, take an active part in the excretory process. There is little doubt, however, but that the chief function of the Malpighian bodies is a mechanic and not a secretory one, and in those conditions in which the excretion of fluid and inorganic salts is defective, the lesions are chiefly found in the circulatory mechanism of the Malpighian bodies. A direct relationship between blood pressure, for example, and the watery secretion of the urine has been thoroughly established. In addition, however, a large amount of the albumin in albuminuria and of the sugar in glycosuria is probably excreted through the Malpighian bodies, and it is likely that in these conditions at least the epithelium of the capsule of Bowman does play an active secretory rôle.

Abundant researches have shown that the epithelium of the convoluted tubules— and with these we include the spiral and the irregular tubules—is active in the excretion of urea and allied bodies. Relatively, the function of these portions of the renal parenchyma is more important than is that of the Malpighian bodies, for urea and its allied substances constitute the most important waste-

products of the body—those most actively poisonous to the tissues, and the excretion of which is dependent largely on a healthy condition of the renal tissue. Hence is those diseases of the kidney chiefly characterized by toxic symptoms, or in which autotoxemia plays an important primary or symptomatic part, that the activity of these tubules is found defective. Although the question of blood pressure also enters largely into the functional requirements of these tubes, their activity is chiefly dependent on the primary action of the tubular epithelial cells.

Notwithstanding the fact that the renal epithelium has a separate nerve supply (Berkeley), the chief nervous control of the kidney is supplied through fibers distributed to the vessels. The influence of central nervous control on the renal function is too well known to require a detailed discussion here.

Although the possibility of the existence of an internal renal secretion cannot be disproved, the chief function of the kidney is the excretion of urine; this, as previously stated, is a very complex process.

The quantity of urine voided is dependent primarily on the amount of water taken with the food or as drink, and, secondarily, on the quantity of fluid excreted by other organs, such as the bowel or by the skin. Ordinarily, the amount varies between 1200 c.c. and 1800 c.c. daily, though it may be much smaller, as, for instance, in profuse diaphoresis; or, on the other hand, it may exceed this amount, as, for example, when large quantities of water or other fluids are taken.

Experiments carried on by means of catheterization of the ureters show that in normal kidneys, provided the size is the same, each kidney secretes in a given space of time almost exactly the same amount of urine, although they do not necessarily act synchronously. The amount of fluid and of solid constituents from each kidney separately will not vary much over 10 per cent.

The Urine.—Immediately after being passed, and while still at the temperature of the body, the urine should be perfectly clear, a turbidity at this time indicating some unnatural or diseased condition; on being allowed to stand, however, a precipitate may form, when, after cooling, elements may be precipitated

out that are not abnormal to the urine; or, on undergoing fermentation, the chemic characters may be altogether altered, causing the precipitation of various substances, such as the alkaline phosphates.

Normally, the *color* of the urine is some shade of yellow,—"straw color,"—the degree of pigmentation being dependent on many conditions, and varying greatly not only in intensity, but also in color. The degree of pigmentation is due to the presence of four substances—urochrome, urobilin, uroerythrin, and hematoporphyrin—which are chiefly derivatives of the blood and bile.

Normal urine is acid in *reaction*, the acidity being due to an excess of diacid sodium phosphate. The reaction fluctuates considerably under normal conditions, being largely dependent on the food ingested and on the amount of the urinary fluid.

The *specific gravity* of normal urine varies greatly under many physiologic as well as pathologic conditions. It is dependent in large measure on the relative amount of liquids and solids ingested. Roughly, it may be said normally to fluctuate between 1.012 and 1.025.

The normal *chemic composition* of the urine is dependent, naturally, on the nature and amount of food and drink taken, on the action of the tissues of the body under normal or abnormal conditions, and on the amount of tissue-waste.

Bunge gives the following tables, based on a diet of beef with salt and water, and on a diet of bread, butter, and water, computed as the result of an analysis of the total twenty-four-hour urine of a healthy young man:

	Meat Diet.	Bread Diet.
Total amount	1672 c.c	1920 c.c.
Urea	67.2 gm.	20.3 gm.
Creatinin	2.163 "	0.961 "
Uric acid	1.398 "	9.253 "
Sulphuric acid (total)	4.674 "	1.265 "
Phosphoric acid	3.437 "	1.658 "
Calcium	0.328 "	0.339 "
Magnesium	0.294 "	0.139 "
Potassium	3.308 "	1.314 "
Sodium	3.391 "	3.923 "
Chlorin	3.817 "	4.996 "

Urea, the most important organic salt of the urine, is the end-product of the decomposition of the albuminoids of the food and of the proteid metabolism of the body. It exists in the blood, is not a renal product, and its only relation to the kidney seems to be that it is normally excreted in greater part by this gland. The amount of urea found in the urine, minus that derived from the decomposition of the albuminous portions of the absorbed food, may be taken as a measure of the proteid metabolic waste of the body. The amount of urea is increased particularly in the acute febrile diseases and in diabetes. It is often entirely absent in acute yellow atrophy of the liver, where it is represented by less highly oxidized bodies, as leucin and tyrosin. (Concerning the chemistry of urea, the reader is referred to works on physiologic chemistry.)

The determination of the amount of urea present in the urine is often very important in clinical medicine. In determining this, however, as pointed out by Cabot, insufficient attention is often paid to the amount of albuminous food taken in as compared with the amount excreted.

Uric acid is formed as the result of the decomposition of the nucleins either of the food or of the body-tissues. It is formed in most of the organs of the body. It appears normally in the urine in small quantities, being derived chiefly, according to Horbaczewski, from the nuclei of the leukocytes. In man the uric acid derived from the purin substances is largely transformed into the more soluble urea; the amount excreted, therefore, also depends partly on the extent to which this oxidation takes place.

COMPENSATION IN RENAL DISEASE

Although the kidney is the chief excretory organ of the body, its relationship and connection with certain other excretory organs have been well established. This is particularly true as regards the skin and the intestine, it being well known that these may take on the renal functions, at least to a limited degree, when the function of the kidney becomes impaired. In man and the higher mammals it seems probable that the other excretory organs cannot assume the renal function completely, though in certain of the lower forms of animals this seems to be possible.

It has been shown that bilateral nephrectomy, ligation of both ureters, or, in other words, total annihilation of the renal function, results in death in from seven to fourteen days (Martin), notwithstanding the fact that the other excretory organs have reached their highest degree of activity. Northrup reports an undoubted case of total suppression of the urine lasting for five days, but followed by resumption of excretion and recovery.[1]

Conversely, the kidney may assume the function of the other excretory organs; this takes place not only in disease, but also in certain physiologic states. Thus in cold weather when the superficial capillaries are contracted and the excretion of water in the form of sweat is diminished, urinary excretion is markedly augmented; on the other hand, during hot weather, when the perspiration is abundant, the urine is excreted in small amounts; this takes place also in diarrhea, when the amount of water discharged by the bowel is great. These facts are often taken advantage of in the treatment of renal, intestinal, and dermal affections. Thus in severe constipation, intestinal obstruction, or in other conditions when the bowel is no longer able fully to carry on its function, the kidney may, to a certain degree, temporarily assume some of the activities of the affected organ. Clinically, when the above-mentioned conditions exist, it is well to maintain the renal activity at its highest point; at the same time every possible care must be exercised to guard against overactivity lest the function of the renal organs become impaired and suppression of the urinary secretion follow.

In cases of grave nephritic disease the bowel also casts off, although perhaps incompletely, certain of the substances that would normally be thrown off by the kidney; in nearly all forms of renal disorder, therefore, it is particularly necessary to see that the excretory functions of the bowel and skin be maintained at their highest point of efficiency. In spite of this close interdependence of function it is doubtless true that when one organ does not act in a normal manner, poisons are thrown into the blood and lymph that may produce most serious disease of the functionating parenchyma of the other; thus, for example, in intestinal ob-

[1] Transactions of the Association of American Physicians, 1910.

struction, in toxic dysentery, and in other similar conditions grave nephritic complications are particularly likely to occur.

A remarkable fact, in this connection, is that, occasionally, in spite of extensive disease of the kidney, resulting in some cases in almost complete destruction of the parenchyma, the patient may continue to live in apparent health. This is well exemplified in congenital cystic kidney, when, as in the case illustrated in fig. 88, apparently the entire normal renal tissue may be absent and yet life continue until an intercurrent affection arises that may unbalance the well-compensated excretion carried on, for the most part, by the bowel and skin. Perhaps one of the most familiar illustrations of this is seen in cases of severe chronic interstitial nephritis, in which the urine secreted by the extensively diseased kidneys differs from normal urine in so far that the waste-products of cell-metabolism are largely absent. Undoubtedly, in some of these cases, a too unfavorable prognosis is given; this would be modified somewhat if, in each particular instance, the compensatory action of the other excretory viscera was thoroughly considered.

In contradistinction to what has been said, it is surprising what minute renal lesions may result in speedy death. This is most likely to occur in acute cases, as, for example, in acute eclampsia, where the subsidiary organs are unprepared to take on compensatory action; in these cases the efforts should be directed toward establishing compensatory action by other excretory organs, rather than toward stimulating an already overworked and extensively diseased kidney.

When, because of disease of the other excretory organs, the kidney is suddenly called upon to assume compensatory activity, it may be unprepared to respond to the demand and acute nephritis and uremia may follow as a consequence. This is probably best illustrated by those cases in which the secretion of sweat is suddenly arrested, as when the surface of the body has been quickly chilled, by the familiar example of the boy who was coated with gold-leaf, or, as has been personally observed, after early or too prolonged sea-bathing. As a frequent illustration may also be cited cases of extensive burns, where large areas of skin have been injured or destroyed, death usually following from acute nephritis.

In these cases the development of renal lesions is not dependent so much on the degree of severity of the burns as on their extent, this latter affecting the amount of sporadic activity suddenly demanded of the renal tissues. Death caused by nephritis following but limited burns is probably not uncommonly due to a previously impaired renal activity. That this failure on the part of the kidneys to respond is due to the abruptness of the demand is well illustrated by the fact that nephritis with fatal termination does not generally occur when the excretory powers of the skin or bowel are slowly obtunded, as in stricture of the bowel resulting from gradual occlusion due to peritoneal or neoplastic adhesions; nor from suppression of the dermal excretion in morphea or scleroderma when the excretory functions of the skin are slowly obliterated. In short, it would appear that the kidney must be given time to accommodate itself to the increased demands upon its functional capacity. This is a most important fact to be borne in mind in considering the treatment of these conditions, it being evident that certain changes must take place in the organ before it is able thus vicariously to functionate.

As has been stated, the size of the normal kidney is proportionate to the body weight; the larger the man, therefore, the greater the amount of renal tissue necessary to carry on the excretory process. From this it would appear that there is a certain definite relation between kidney bulk and kidney function, and it may be assumed that when increased function is demanded of the organ, an increase in the parenchymatous epithelium takes place. That this occurs has been abundantly proved by studies in pathologic anatomy and in experimental pathology.

Compensatory hyperplasia of the kidney may take place in the fetus; for if, because of some defect, the anlage for one kidney is insufficiently nourished, the other organ will show a compensatory hyperplasia of the epithelium. This is well exemplified by those cases in which but a single kidney exists, the one organ being found to bear approximately the relative weight to the body that the two kidneys bear in normal cases. Compensatory hyperplasia is by no means limited to the fetal condition. When it becomes necessary, therefore, to remove one kidney, the remaining organ, if healthy, may be expected to show an increase

in its parenchyma and eventually to carry on the entire renal function in a satisfactory manner. In a young and healthy subject the remaining organ will eventually attain a weight equal to that normal for the two kidneys. From what has been said it is clear that a certain length of time is necessarily required to effect epithelial hyperplasia, and in these cases it is essential that means be devised for facilitating compensatory excretion on the part of other organs until sufficient time has elapsed for the necessary epithelial growth to take place. This epithelial hyperplasia undoubtedly occurs in most of the compensatory conditions that have been considered. If sufficient time has not elapsed for this to take place, the organ is suddenly overwhelmed with poisonous waste-materials, which it is unable to handle, and which, consequently, act on the renal cells as cytotoxins.

Compensatory hyperplasia is a process that is not limited to any particular portion of the cortex. For instance, if infarction destroys a portion of the cortex of one kidney, compensatory hyperplasia may take place in the opposite organ or in other portions of the cortex of the injured viscus. The degree of hyperplasia varies greatly. In healing scarlatinal nephritis, where extensive desquamation of tubular epithelium has taken place, the process may consist merely of replacement of the diseased cells by newly formed ones on the old basement membrane; or, on the other hand, the actual formation of new tubes may occur. This latter fact has been disputed by some observers, but has been thoroughly substantiated by experimental work.

Naturally, compensatory hyperplasia is most likely to take place during youth and when the kidneys themselves are in a comparatively normal condition; nevertheless, it often occurs in old age and in diseased conditions where it is least expected. Hyperplasia is, of course, limited largely to the parenchyma and chiefly to the cortex. It is most unlikely to occur when pronounced interstitial alterations have occurred. It is the essential change in nearly all healing processes that follow any of the types of nephritis, and the process is undoubtedly accelerated by the various methods shown by experience to be valuable in the treatment of patients convalescent from renal disorders.

CHAPTER VI

THE BLOOD IN DISEASES OF THE KIDNEY

Revolutionary advances have been made within the past few years in the study of blood in diseases of the kidney. These researches have done more to direct the modern concept and clinical study of renal disease than any other single factor since clinical study of the urine became general. Not only have these studies served to lead us to a new and eminently practical viewpoint of the blood changes in renal disease, but they have also thrown much light on the physiology of the kidney, and at this time they appear to furnish us with accurate data on which to base prognosis in several types of renal disease.

Unfortunately as yet the blood changes which occur in kidney defects have not, as Ewing criticizes, been coupled up and identified with certain pathologic changes. There can, however, be no doubt but that in the near future this side of the picture will also be placed on a certain basis, and it is quite possible that we shall then be in a position to satisfactorily classify, prognose, and treat kidney disease, a point from which we are as yet widely removed.

These studies are chiefly chemical in nature, and while from the viewpoint of the expert chemist they present no particularly difficult problem, the methods are not as yet such as may be applied by the ordinary clinician, although their application is so simple and direct that without an intimate knowledge of chemical technic they may be fully comprehended and used by any serious clinical student. We shall, therefore, make an attempt to discuss this matter from the stand of the technical chemist, and the reader is referred to the numerous researches published in every journal devoted to this branch of medical work for technical considerations. Suffice it to say that the amount of blood required is astonishingly small, 10 or 15 c.c. being ample for nearly all necessary studies for clinical purposes.

In general, it is advisable or necessary to conduct these studies

comparatively with accurate quantitative studies of the urine, and since it has been shown that the diet very directly effects the character of the blood in both health and disease, it is necessary also for proper judgment to know at least approximately the amount of the various food elements which enter into the diet of any patient under question. This may be very simply effected by placing the patient upon a milk diet of known amount, though it is advisable to know also the amount of salts and ash intake. Obviously the fluid intake is of very elemental importance, and whether or not edema is present and its degree has also great import.

Studies in renal permeability have shown without apparent exception that where permeability is diminished the blood invariably shows changes indicating a storing up in the blood of materials which in physiologic states are excreted by the kidney. This particularly, and quite in accord with our previous concept of renal disease, applies to the nitrogenous elements.

In most if not in all types of renal defects this condition is often indicated by a retention of nitrogen within the body fluids and notably in the blood. This nitrogen appears in the form of filterable nitrogen, and the amount of nitrogen thus retained in the blood may total up to as much as four to seven times that normally present. On a known diet, with a determined quantitative urinary study, the amount of retained nitrogen may, in our opinion, be fairly taken as an indication of the severity of the renal defect, and it is in high degree of prognostic value. For our own clinical studies we have in most cases been content to determine this total amount of retained nitrogen, but some clinicians prefer to further amplify this by a nitrogen partition in which the various forms of retained nitrogen are relatively determined and considered. Certain students thus believe that the amount of creatinin retained within the blood is the most important element, others that the blood urea is the most certain measure of the degree of renal incompetence. Halsey, Chase, and others associated with them believe that the earliest blood evidence of beginning kidney disease is the retention of uric acid in abnormal and increasing amounts in the blood. If this be true it may seem that there is a close relationship between gout and early renal disease. From our personal study, con-

ducted mostly in regard to gout primarily, we are unable to corroborate this supposition.

While there can be no question whatever but that much is yet to be learned from close study by nitrogen partition methods, we are of the opinion that for clinical purposes, and taking into consideration the time and expense necessary for the more elaborate determinations, the simple determination of the total retained filterable nitrogen is quite sufficient.

Less study has thus far been reported concerning the variation in the salt content in the blood in the various forms of renal inadequacy, but we are all convinced that as the technic of the subject becomes perfected and simplified that much very direct and valuable evidence will be furnished in many, if not in all, cases of kidney disease. This is probably particularly true of quantitative studies of NaCl. We know that particularly in kidney disease in which the glomerulus is obliterated by fibrous growth the excretion of sodium chlorid is particularly hindered, and this doubtless contributes very largely to edema in those instances of nephritis where this appears as an important symptom. We have noted in several cases that although the excretion of NaCl by the urine was greatly diminished, and the giving of this drug failed to cause a raise in the concentration of the urine in this respect, yet salt was not found in increased amounts in the blood as appears to be usually the case, but that the chemical appeared to be bound either in the muscles and subcutaneous tissues or in the edematous fluid itself.

Though we are completely convinced of the great value and importance of these blood studies in cases of clinical renal disease, and though we believe that they offer diagnostic and prognostic data to be obtained in no other way, physicans are cautioned not to accept as final and conclusive such data as compared to the facts which appear when every aspect of the case is considered from the clinical standpoint. Cases have been under our observation which died and were proved by autopsy to have been bonafide instances of interstitial nephritis in which nonetheless absolutely no blood indications of the renal disease could be shown, and we have also had cases in which the blood findings indicated the most serious and rapidly fatal possible type of kidney disease apparently, and yet which survived for long periods of time. We have in this method a

most valuable and hopeful addition to our methods of study of kidney disease, but, like most things in medicine, it is by no means certain or infallible, and while it adds to, it in no essential way displaces, the older methods of clinical observation. As an outgrowth of these studies, particularly when conducted in association with careful urinary studies, computations of the blood-pressure, etc., numerous so-called tests or ratios have been worked out, the so-called color reaction of Larkin and Lewy, the Ambard index, and others which are supposed to give certain knowledge as to the outcome or actual status of any case. We, like most others, have had periods of great faith in this or that test, but as our experience has multiplied this has given way to only a more firm reliance on the value of the clinical picture of each individual case, taken as a problem by itself.

Microscopic examination of the blood is valuable in the diagnosis of kidney diseases only to a very limited degree. Unquestionably, its greatest diagnostic usefulness is in suspected renal suppuration.

Polynuclear leukocytosis is generally concomitant with *suppurative diseases of the kidney*, except when the drainage from the suppurative focus is free; it has then been found, as a rule, that leukocytosis, at least in marked degree, is often absent. In these instances, when pus escapes freely, the question as to the presence or absence of suppuration can be readily settled since pus is found in the urine or escaping through a fistulous opening. When the pus does not escape, the polynuclear leukocytes are commonly increased, the degree of leukocytosis depending, in the writers' experience, on the extent and virulence of the purulent process. As exceptions to this general rule may be cited the absence of leukocytosis in old and well-localized pus-formations, also in those rarer instances where the infective process is so overwhelming that the production of leukocytosis seems to be inhibited. In suppurative disease localized to the kidneys the number of leukocytes rarely exceeds 20,000, and is more often in the neighborhood of from 12,000 to 15,000.

In *tubercular nephritis*, as a rule, the leukocytes are not increased unless the tubercular process is complicated by a mixed infection with other pyogenic bacteria. On the contrary, hypoleukocy-

tosis may be present, and a differential count of the leukocytes may show a relative increase in the mononuclear elements, although not so regularly as in general tubercular disease.

In *new-growths of the kidneys* the blood shows the same general characteristics seen in new-growths elsewhere, but the cachectic type of anemia may serve, in a certain number of cases, to distinguish renal growths from abscesses or non-neoplastic hypertrophy.

Nephritis furnishes some of the most important blood-picture changes in renal disease, such changes occurring, of course, secondarily; in pernicious and other severe anemias, however, nephritis itself often arises as a secondary condition.

In *acute nephritis* an anemia occurs that is usually characterized by a proportionate reduction in hemoglobin and red cells. It is commonly believed to be due directly to the loss of blood with the urine, but it is often too marked in degree to be accounted for on this basis alone; besides, it develops in some cases in which no loss of blood can be demonstrated. Leukocytosis with a count of 20,000 has been noted by some observers (Cabot), but, in the writers' experience, it is not constant or sufficiently frequent to render it of diagnostic value. It is probable, at least in a certain number of cases, that this leukocytosis is a relative one only, and due to loss of the red corpuscles.

When edema of considerable degree is present, hydremia may often be found a symptom of much importance. Although, as a rule, the coagulability of the blood is not altered in markedly hydremic cases, it may be markedly decreased; at the same time, when the loss of blood from renal hemorrhage has been considerable, coagulability may be increased.

The alkalinity of the blood sometimes falls below normal; in the acute diseases, as a rule, it has been found to be unaffected.

In *subacute* or *chronic parenchymatous nephritis*, when the parenchyma of the kidneys is chiefly affected, the most characteristic forms of anemia develop. In certain cases, however, the anemic condition is more apparent than real, and pallor of the skin and mucosæ may be found associated with practically normal blood-findings. It is quite probable, in at least some of these cases, that though the blood itself is normal in its commonly recognized characteristics, there is an inability on the part of the tissues to take

up the requisite amount of oxygen and nourishment from the circulating stream.

The hemoglobin is markedly reduced, occasionally falling as low as from 30 to 40 per cent., whereas the number of red corpuscles, though generally somewhat lowered, is proportionately less so. This gives a blood-picture not unlike that of chlorosis, a disease that is frequently confused with nephritis, and, when the examination is not thorough, nephritis is often mistaken for chlorosis.

As a rule, in those cases, the leukocytes are somewhat increased relatively, though they rarely exceed from 10,000 to 12,000, and a differential count establishes the fact that the relative percentage is normal, thus differentiating this condition from one of absolute leukocytosis.

The alkalinity of the blood is generally somewhat reduced; this is quite a constant finding in this type of nephritis. As in the acute form of the disease, coagulability may be lowered.

Anemia often becomes a matter of grave significance in nephritis of this form, and its treatment is of the utmost importance. There can be no doubt, in a certain number of cases at least, that the dietetic restrictions that form part of the treatment of the renal condition are in some measure responsible for the anemia, and this fact must be held in consideration.

In *chronic interstitial nephritis* the blood, as a rule, shows no microscopic variations that are directly attributable to the renal disease. When the circulation has become slowed, as in certain of the circulatory and cardiac manifestations of nephritis of this type, the hemoglobin percentage and the red-cell count may even be increased and a true oligocythemia develop. In these cases, naturally, if secondary conditions play an important rôle, as when epistaxis is frequent, anemia may develop secondarily. When due to other and perhaps primary conditions, anemia may also produce an entirely different blood-picture. Thus in the chronic interstitial nephritis that occurs in lead-poisoning a profound anemia is a prominent symptom; occasionally it simulates a primary anemia, and is generally evinced by marked granular degenerative alterations in the red cells.

In *uremia* the blood may show any of the changes associated

with the special type of nephritis that is present, but an almost constant manifestation is a marked reduction in alkalinity, falling rapidly as the case becomes more grave and increasing as the uremic symptoms disappear. The leukocytes are also rather constantly increased in uremia (Ewing). Pieraccini has found that the number of eosinophile leukocytes is considerably diminished in uremia, this diminution corresponding to the severity of the case and to the decrease preceding the development of uremic symptoms; its occurrence, therefore, may be regarded as a symptom of some prognostic value.

The treatment of hemic disturbances arising in the course of renal disease practically resolves itself into a treatment of the nephritic anemia. The course pursued in similar conditions arising independently or occurring during the progress of many other diseases must be considerably modified in nephritis. This is particularly true of dietetic measures, for the food that is indicated in other types of anemia must, because of its deleterious action on the kidney, be forbidden in nephritis. Thus it may be necessary to limit eggs, beef-juice, and foods of a similar nature. Lemonade and milk, which act very beneficially in anemia generally, may be employed in these cases with actual benefit to the renal tissue and often with markedly good effects on the anemia. The same applies to the use of green vegetables, such as spinach, lettuce, and so on. The outdoor treatment of nephritic anemia is also attended with excellent results. Patients should be encouraged to spend as much time as possible out-of-doors, particularly in the sunshine; and suitable exercise, as indicated by the existing conditions, should be prescribed.

Like the anemia of chlorosis, which it so closely simulates in many respects, the anemia of nephritis, as a rule, responds promptly to ferrous medication. In most cases the writers have found that the inorganic preparations of iron act more beneficially than the organic; in certain cases, however, better results have been attained by the employment of organic ferrous compounds. The two preparations that, in the writers' experience, have proved most efficacious have been the tincture of the chlorid and the familiar "Basham's mixture," both given in large doses. The sulphate or carbonate, or the combination in the form of Blaud's

pill, also acts very beneficially. The tartrate of iron and potash is especially efficient, since in addition to its ferruginous qualities it does not constipate. In other respects the treatment is to be directed toward the underlying nephritis.

When the case is not of too long standing and is uncomplicated by other diseases, as a rule, nephritic anemia responds promptly to well-directed treatment. Oftentimes the treatment, though entirely ferruginous and directed to the correction of the anemia, results in a marked improvement in the general renal disturbance. This has been found to be particularly true of those cases of nephritis complicating the convalescence from the infectious diseases. As a result of iron medication albuminuria tends to disappear more rapidly, edema subsides, and the general vascular tone improves so markedly that, in some cases of nephritis, apart from its effect on the anemia, iron seems to be almost a specific.

THE BLOOD-PRESSURE IN RENAL DISEASE

That there is an increased blood-pressure in many types of renal disturbances is a fact that has long been recognized, but our knowledge in regard to the constancy of its occurrence in certain diseases and the clinical methods devised for accurately and easily determining its existence are recent acquisitions to this branch of study. For these we are indebted in large measure to the recent admirable contribution of T. C. Janeway, "The Clinical Study of Blood-pressure," where this imporant manifestation has been most completely discussed in all its aspects. The writers have found, by constant routine employment of the sphygmomanometer for the past years, that we possess in this instrument not only one of the most definite and constant means of diagnosing obscure cases of nephritis, but also a valuable aid in the prognosis of renal disease, and an accurate and certain method of determining the effects of treatment.

For clinical purposes the instrument known as the Janeway, or Kaplan's modification of this instrument, is to be recommended for the use of the general practitioner. Of the other instruments suitable for general clinical use, the Riva-Rocci has given the best results in the writers' hands. Recently a very convenient

instrument has been designed by Dr. O. H. Rogers. The pressure is registered by a circular spring dial, virtually an aneroid. Thus far the apparatus has proved accurate in our hands; most instruments depending on this principle have, however, not proved

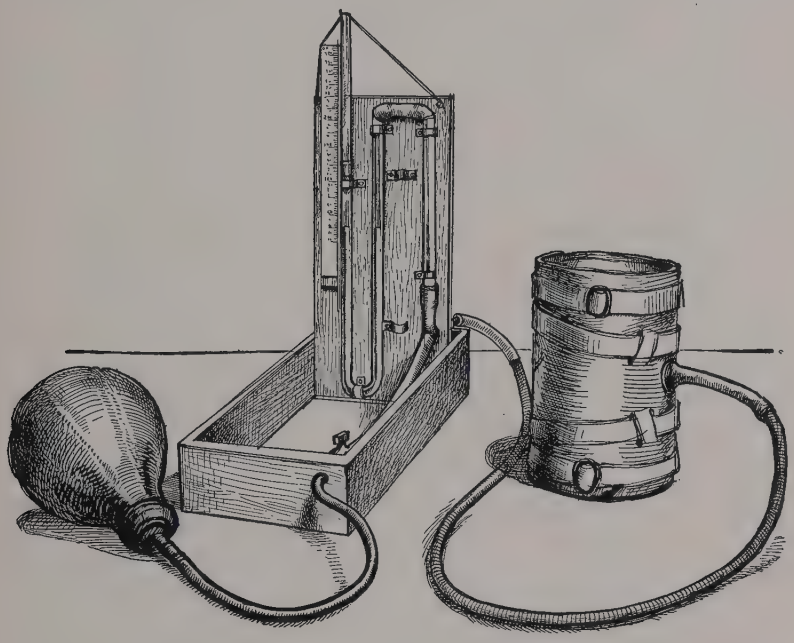


Fig. 72.—The Janeway sphygmomanometer.

satisfactory heretofore, and the writers usually employ for work outside the office and hospital the compact and portable instrument designed by Prof. Sahli. Where accurate graphic records are desirable in hospital or research work the Erlanger instrument doubtless affords the greatest range of possibility.

Experience has corroborated the statements made by Janeway and the other observers quoted by him. To secure accurate results with the instrument, a certain amount of practice is necessary, although the technic essential for its efficient employment is readily acquired. In order to obtain accurate results, several determinations should be made, at different times and under varying conditions, as with the patient sitting, standing, or lying down; this, particularly with a view to avoiding the possibility

of psychic stimulation, which might, in some cases, lead to erroneous conclusions.

The blood-pressure cannot be satisfactorily estimated merely from an examination of the pulse, even by the most skilful clinician.

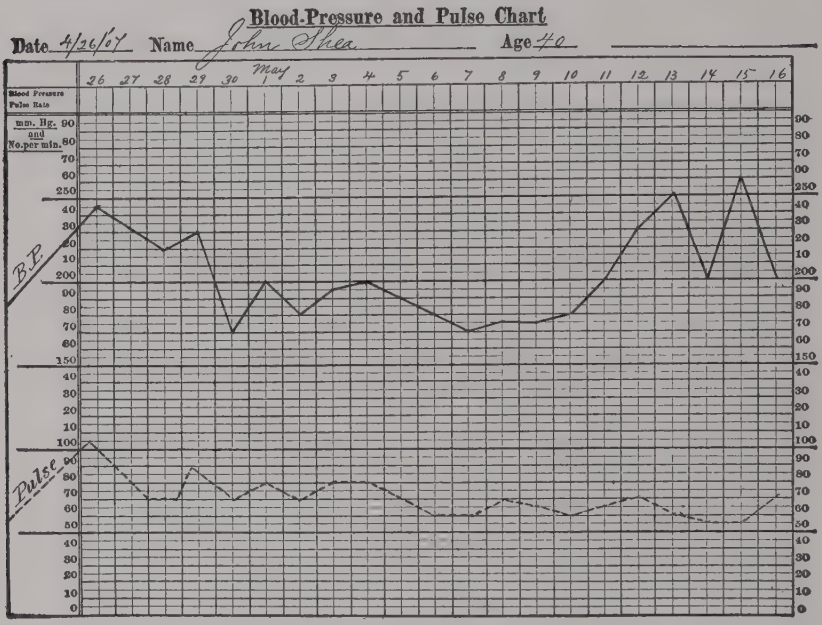

Blood-Pressure and Pulse Chart
Date 4/26/07 Name John Shea Age 40
April 26 27 28 29 30 May 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Blood Pressure Pulse Rate
mm. Hg. and No. per min.
B.P.
Pulse

Fig. 73.—Bedside chart, showing a convenient way of recording blood-pressure and pulse-rate. From a case of chronic interstitial nephritis.

Repeated experiments designed to demonstrate the value of this as a guide to ascertaining the amount of blood-pressure have shown that but little reliance is to be placed on this method alone. The estimates of most reliable clinicians have varied from the sphygmomanometric determination as much as from 60 to 100 mm. of mercury.

In acute nephritis the blood-pressure variations are marked. In the early stages of the disease there is commonly, and often a considerable, increase, but there may be a decrease, even to the subnormal, particularly when cardiac failure is imminent. In the nephritis complicating the acute infections experience has shown that the pressure is either normal or subnormal, and that if increased, it is but slightly so. In these conditions the deter-

mination of the blood-pressure is of little value excepting in so far as it may be used to differentiate between the acute exacerbation of a chronic nephritis and an acute nephritis; in the former condition the blood-pressure is constantly high, and in the latter it is usually but little altered, although occasional acute cases are seen in which the pressure is as high as in chronic cases.

In chronic or subacute nephritis, in which the pachydermatous portions of the kidney chiefly are involved, the pressure is, as a rule, high, although in the writers' experience it rarely exceeds 170 to 200 mm. Hg°. In certain cases, however, especially when there is a loss of vascular tone, as in myocarditis or disease of the arterial media, the pressure may be below normal, reaching as low as 85 mm. Hg° (systolic pressure). In those forms of renal disease in which edema is present, it must be borne in mind that an edematous condition of the arm may materially alter the results of the determination, and in such cases no absolute reliance can be placed on the data secured by the sphygmomanometer.

The blood-pressure is constantly increased in that type of renal disease chiefly characterized by fibrous hyperplasia, and it is immaterial whether this occurs in the small granular, so-called "sclerotic" kidney, or in the large red organ; the latter, in the writers' opinion, very often precedes the sclerotic, and represents one of the early stages in the development of the small hard kidney.

In these conditions the blood-pressure is almost invariably increased, often reaching above 250 mm. of Hg°. This can frequently be detected by means of the blood-pressure apparatus, long before it is possible to discover definite alterations in the heart or liver by the usual clinical methods of examination. This increase of pressure often also renders a diagnosis of renal disease possible even when oft-repeated and careful urinary examinations fail to demonstrate the presence of any definite kidney lesion.

In the prognosis of renal diseases blood-pressure determinations have also given satisfactory aid. In nearly all forms of renal diseases, and particularly in those cases in which fibrous hyperplasia is the most dominant change, the blood-pressure varies but little when the patient is progressing favorably, and in these cases it has been known to gradually drop almost to the normal, invariably to rise again before any acute manifesta-

tions of renewed disease appear. A continuously high pressure should, of course, warn the physician of the danger of arterial rupture, and a sudden or marked fall is a serious prognostic sign indicative of cardiovascular failure.

In the treatment of renal disease the blood-pressure has also been found a very satisfactory means of gaging the progress made. Thus, a reduction of an abnormally high blood-pressure may be observed after the prolonged administration of potassium iodid or following the use of chloral or other vasodilators and overstimulation with such drugs as caffein, digitalis, ergot, and strychnin is suggested by a raise in pressure. All in all, a regularly kept blood-pressure and pulse chart plotted with the fluid and urine curves is, in our experience, a most helpful guide in the course of a case of nephritis.

The writers, however, feel that there is now a general tendency to overestimate the dangers of high blood-pressure and to resort to frantic measures to artificially reduce it, quite forgetting the fact that a high blood-pressure is absolutely essential in some types of nephritis for the proper function of the kidney, and a reduction of the pressure below this point only results in more defective renal action and in greater eventual strain on the excretory and cardiovascular system. We deprecate the routine use of vasodilators in the high pressure of renal disease. Great judgment must be exercised in this respect, and each individual case should be considered as a law unto itself.

CHAPTER VII

THE OCULAR MANIFESTATIONS OF RENAL DISEASES

By RICHARD KALISH, A.M., M.D.,

NEW YORK

The ocular manifestations are of signal importance as aids to the diagnosis of renal disease.

Edema of the lower eyelids has, by some writers, been considered indicative of beginning nephritis, but in the early stages of the disease this is of only a transitory nature, and as it likewise occurs in the course of many other systemic maladies, it has little diagnostic significance. In the terminal stages of nephritis, when the edema of the eyelids has become a permanent feature, the marked general ascites is so distinctive that the presence or absence of involvement of the eyelids has no diagnostic value.

Edema of the conjunctiva has also been attributed to nephritis; when this condition accompanies intra-ocular inflammation and its severity is disproportioned to the mildness of the deeper seated trouble, suspicion should be aroused. In a case seen by the writer a mild attack of rheumatic iritis was complicated by so intense a chemosis as to prevent apposition of the eyelids. Urinalysis then disclosed that the patient was passing through the early stage of an unsuspected interstitial nephritis.

In patients who have passed their fortieth year both subconjunctival and subcutaneous hemorrhages, especially of the lower eyelid, if recurrent, demand an examination of the kidneys. The hemorrhages usually come on during the night and cause no pain; the left eye is the one usually affected. Recurrence may ensue at longer or shorter intervals, often but a few weeks intervening between the attacks. Occasionally they are the only manifestations of the systemic disease, and precede, by quite an interval, the usual and classic symptoms; they may also be associated with other hemorrhages incident to nephritis, such as purpura,

epistaxis, retinal hemorrhage, etc., caused by a general arteriosclerosis, even if this condition is not discernible in the superficial arteries.

Exophthalmos due to effusion in Tenon's capsule has been observed in the course of albuminuria. Recently Barker has called attention to its relatively frequent occurrence in chronic nephritis.

External ophthalmoplegia has occasionally been observed among the terminal symptoms, but it sometimes occurs early in nephritis, and in this event recovery is rapid, although relapse is common, and muscles may be involved successively. These paralyses are undoubtedly indicative of changes in the cerebral vessels identical with those in the retina.

The intra-ocular appearances accompanying or produced by nephritis are often the first evidences of renal disease, and lead to a recognition of the malady before any general symptoms arise. The most important condition is albuminuric retinitis, the ophthalmic picture of which is easily recognized. The retina usually appears as an edematous, light-gray membrane, with or without patches of exudation and with darker stripes traversing its posterior part.

The arteries are reduced in size, thin, bright colored, and frequently defined by whitish stripes; the veins are broad, flattened, twisted, and dark red in color, and may be covered by the exudate or may pass over it.

The outline of the nerve-head is hazy, and in some cases indistinguishable, the optic disc apparently going over into the retina with no perceptible line of demarcation. It appears reddish, swollen, and opaque. Around the nerve-head, and several times its diameter, is often found a zone marked by extravasation of blood, bright flaming red in color, with well-defined rounded spots or broad, flat stripes, which vary in size and number. White or yellowish spots, often surrounding the optic nerve, are likewise seen in this band, and small, shiny, silvery points are scattered over the retina. The macula is usually red, and surrounded by a band studded with white spots, or with the characteristic halo or star-like arrangement of small bands or spots. It is generally accepted that there is but one kind of nephritic retinitis, and that the different forms and changes observed are indicative only of various stages of edema, hemorrhage, exudation, and

degeneration. Albuminuric retinitis is generally bilateral, but may not begin in both eyes at the same time nor develop equally. It may occur at any time, but comes on most frequently between the ages of fifty and sixty, the youngest recorded case occurring in a child five years of age.

The form of nephritis most frequently complicated with retinitis is the chronic interstitial variety, but retinitis may develop in any form of renal disease, even in the acute, as in scarlatina or in the course of pregnancy. In short, it may arise in any variety of renal disease that can cause albuminuria, and is found, though rarely, in the course of carbuncle, diphtheria, erysipelas, the intermittent fevers, measles, smallpox, typhus, and in poisoning by alcohol, cantharides, croton-oil, or lead. Albuminuric retinitis occurs in from 9 to 11 per cent. of the cases of nephritis.

The extent of the retinitis bears no relation to the intensity of the renal affection or to the amount of albumin contained in the urine.

The degree of the visual impairment depends upon the extent and location of the hemorrhages and deposits, rather than upon the stage of the malady, and varies from a slight impairment of sight to complete blindness, although this latter is extremely rare. Hemorrhage into the macula produces a marked diminution of vision, as does optic neuritis which causes subsequent atrophy of the nerve; but, as a rule, visual reduction is markedly disproportioned to the ophthalmoscopic picture.

The prognosis as regards life is always grave. Many die during the first and few live beyond the second year. These patients are usually seen late in the disease, after the lesions have existed for some time before being discovered by the oculist; so it is reasonable to infer that the limit of two years from the first occurrence of the retinal complication is hardly accurate.

Although various forms of albuminuric retinitis, albuminuric neuritis, and albuminuric neuroretinitis have been classified by clinicians, they cannot at times be differentiated, and may glide insensibly into one another, and can frequently be seen to merge. The limitations of this article forbid their consideration.

Uremic amaurosis or amblyopia, although less common, is more conspicuous than the retinal complications. Loss of sight

in this is sudden, complete, and usually bilateral, or one eye may be affected primarily, the other becoming blind in a few hours; in rare instances some light perception is retained. The reaction of the pupil to light is generally unimpaired. The condition of the pupil itself varies: sometimes it is dilated, at other times it is contracted, and often it remains unaffected. The result of ophthalmoscopic examination is usually negative, but occasionally a combination with retinitis exists; in this event the retinitis antedates the amblyopia. The urine is scanty or may be suppressed, the specific gravity is high, albumin being present in large quantities. Uremic amaurosis is more common in the forms of nephritis accompanied by uremic attacks, as scarlet fever, pregnancy, acute exacerbation of the chronic form, etc. Restoration of sight is generally sudden and complete, varying in time from a few hours to three or four days. Permanent blindness does not occur except in cases in which there has been a prior retinitis. Recurrence indicates an unfavorable outcome.

SYLLABUS OF OCULAR CONDITIONS ACCOMPANYING OR PRODUCED BY THE DIFFERENT TYPES OF NEPHRITIS

1. Intense conjunctival chemosis occurring with or without intra-ocular inflammatory diseases.

2. Circumorbital subcutaneous and subconjunctival hemorrhages, if recurrent and in patients over forty years of age.

3. Successive external ophthalmoplegias.

4. Iritis, choroiditis, and iridochoroiditis, when not assignable to other causes.

5. Edematous, pale-gray retina, with exudate.

6. Hemorrhages and deposits in and on the retina.

7. Many forms of retinitis, neuritis, and neuroretinitis showing the "albuminuric" picture on ophthalmoscopic examination.

8. Contracted, silver-streaked arteries and dilated, flattened, tortuous veins.

9. Amblyopia or amaurosis with sudden complete blindness, temporary in character, without retinal damage or ophthalmoscopic evidence of intra-ocular disease.

CHAPTER VIII

THE KIDNEY IN ACUTE INFECTIOUS DISEASES.—SUPPURATIVE NEPHRITIS

THE KIDNEY IN ACUTE INFECTIOUS DISEASES

Relatively few diseases really arise primarily in the kidney; as a rule, the renal lesion occurs secondarily and as a complication of some other pathologic condition. For this reason it is deemed best to consider briefly the action of the kidney in some of the more common ailments. Among these, the infectious diseases are probably the most important, both because of the common occurrence and grave nature of this class of diseases and also because of the fact that serious renal complications are particularly prone to arise at some time during their course.

Although the relative frequency of kidney lesions in the acute infectious diseases varies greatly, being, for example, very common and severe in scarlatina, it is not deemed practicable to consider the relationship of the lesion to each individual disease, more particularly since the variations that occur apparently affect the degree or frequency more often than they do the pathologic changes.

There are certain fundamental reasons why renal disease so commonly arises in the infectious processes. In these conditions, in addition to the usual poisons elaborated by the metabolism of the body, the renal tissue is required to excrete toxins generated by bacterial or protozoan growth, together with those elaborated by a disordered metabolism. The poisonous substances that the kidney is called upon to excrete, therefore, are not those to which it has been accustomed, and thus renal irritation or incompetency is readily brought about.

In the acute exanthemata, in addition to getting rid of these foreign toxins, the kidney is called upon to accomplish, by compensatory excretion, the function normally carried on by the skin, and at the same time the diseased skin presents a large surface

for the elaboration of poisons. A practically analogous condition obtains in such diseases as typhoid and dysentery, the excretory powers of the bowel being not only lessened or entirely lost, but also affording a large surface for the development of abnormal metabolic substances with perhaps actual toxin formation. The same conditions also obtain in lobar pneumonia, in which, in addition to toxin production and diminished respiratory excretion, a certain amount of cellular depression must result from limited oxidation.

In even quite sharply localized infectious conditions, and especially in tonsillitis, nephritis develops with considerable frequency, and may, indeed, be the only evidence of a generalization of the infection. In this respect renal disease seems to approximate in frequency of occurrence endocarditis.

Before considering the actual lesions of the kidney that commonly originate in the course of the infections, it must constantly be borne in mind that albuminuria and even the presence of casts and blood in the urine, without actual nephritis existing, are of common occurrence in the early stages of the infectious diseases, and may appear entirely without infarction or other direct kidney lesions. Thus in nearly all the acute infections a preliminary stage of engorgement occurs; during this period albumin and, in the more severe cases, blood and casts as well, may appear in the urine, but under favorable conditions they disappear in the course of a few hours or days, as the circulatory conditions become adjusted. This, as stated, is manifest at the onset of nearly all the acute infections. Under ordinary conditions, as proper circulation becomes reëstablished, these elements disappear from the urine; if, however, they remain present over long periods, or if a secondary inflammatory disease is set up in the kidney, a true nephritis may be ushered in.

The complications that arise as a result of the action of infectious diseases on the kidney may be divided into two groups: those that originate in acute and those that develop in chronic or long-standing cases. A more minute classification is also possible, and the conditions that appear during the course of the acute infections may be grouped as those that are produced by septicemia, from the mere fact of the presence of bacteria

circulating in the blood, and those that seem to be caused chiefly by the action of toxins. The most common condition in which the former occurs is in septicemia or pyemia from any cause whatever, as in puerperal sepsis, endocarditis, and the like. However, it must be remembered that the mere presence of bacteria in the blood is not the sole or final factor, for in all these conditions toxins, at least in part, also play a rôle; it is rare, indeed, that bacteria act only in a mechanic or simple biologic capacity.

The most frequent renal lesion occurring in septic conditions is that of infarction. This is ordinarily manifested by pain in the region of the affected kidney, and by the sudden appearance of blood and albumin in the urine. Often, however, the condition passes unnoticed unless the infarct is of considerable size; this may happen also when other clinical symptoms tend to obscure those of infarction. The blood ordinarily soon disappears from the urine, and the condition is rarely diagnosticated clinically. The infarctions are, as a rule, small, and involve chiefly the cortical portions of the kidney, for the reason that the causative embolus commonly lodges in one of the terminal or interlobular arterioles. The area involved may, however, be sufficiently large to result in necrosis of considerable portions of tissue, and the particular danger in these cases is that bacterial growth terminating in renal abscess may occur in this necrotic medium. If the infarctions are of small size, no symptoms may be present beyond perhaps the sporadic occurrence of albumin and pus in the urine, but this depends largely on the nature of the infecting organisms; if they are tubercular, a general or local tubercular nephritis may arise; in streptococcus septicemia a diffuse septic inflammation of the entire renal substance is likely to occur, while in gonorrheal infections, an active suppuration, usually more or less localized, is most likely to take place. In pneumonia, according to the writers' observation, a diffuse process simulating that seen in streptococcal infections most frequently occurs.

When the general disease is characterized chiefly by the active production of virulent toxins, as in scarlatina, diphtheria, and in certain instances of lobar pneumonia, a diffuse hyperemia of the kidney takes place first, accompanied by albuminuria and casts that, even in the most favorable cases, persist longer than

in simple hyperemic conditions. If the toxemia is sufficiently active, this may proceed until a diffuse nephritis occurs, and the inflammatory process may become so marked that a hemorrhagic infiltration is set up. Albumin, blood, and epithelial casts appear in the urine, which is also diminished in quantity, and all the other manifestations of an acute hemorrhagic nephritis become evident. This is the picture most likely to arise in scarlatina and in smallpox. Even in the milder cases a diffuse parenchymatous nephritis is very prone to develop, and this is one of the most frequent causes of death occurring at the onset of these acute infections, although it may also develop at any stage of the process. Not uncommonly it is found at autopsy that a single kidney is so affected. When but one kidney is the seat of disease, the work of excretion is thrown on the remaining organ, which may, in consequence, undergo compensatory hyperplasia or, on the other hand, it may, in turn, become diseased, in which case a fatal termination generally ensues.

As a rule, when renal disease so occurs there is a sharp rise in the blood-pressure, with a corresponding retention of filterable nitrogen in the blood. In favorable instances pressure then falls to the neighborhood of normal, with a drop in blood nitrogen, to both again gradually increase if interstitial changes occur in the kidney, especially in or about the glomeruli.

The **treatment** of nephritis arising in the course of the acute infections varies according to conditions present in each case. In general it is identical with that demanded in the pure nephritic condition. When abscess of the kidney occurs, it may become necessary to open and drain, but this is rarely the case in the course of the acute general disease. If a diffuse suppuration is present, which, as occasionally happens, transforms the entire substance of one kidney into an abscess cavity, nephrectomy may be imperative. The ordinary methods of treating renal diseases may, however, safely be employed in the acute infections; thus the hot pack, diaphoretics, and remedies tending to stimulate excretion by the bowel are measures that have been found of decided benefit. The dietetic restrictions ordinarily prescribed in the various forms of acute nephritis are indicated here. When ascites, hydrothorax, and similar conditions arise, the treatment should

first consist of tapping or the employment of other mechanic measures rather than of medicinal means.

The **prognosis** is entirely dependent on the individual characteristics of each particular case, and no general statements in regard to it are, therefore, possible.

In these renal complications, as in primary nephritis, the acute condition is very prone to become chronic, and interstitial changes are likely to take place; this is seen, for example, in many cases of typhoid fever. When the infection is of long standing, it is impossible to determine antemortem, either from a clinical or a pathologic standpoint, whether parenchymatous or interstitial changes predominate. As a rule, the lesions go hand in hand, although interstitial hyperplasia is more prominent in prolonged diseases or when the blood-vessels are extensively involved.

When the infection is in itself primarily of a chronic character, as, for example, in syphilis, interstitial manifestations are the predominating characteristics of the renal complications. Thus is brought about the small sclerotic kidney or, less commonly, the large red kidney. In these cases, as in the protracted subacute or acute infections, the degenerative alterations are more commonly of the fatty type, differing in this respect from the changes seen in the more active disease, in which albuminous degeneration is the dominant feature. Fatty degeneration may follow the parenchymatous, or it may originate itself as a primary change. Amyloid degeneration also occurs, especially in syphilis, tuberculosis, and chronic suppurative processes, such as osteomyelitis.

These renal complications, except when they occur in tuberculosis, are clinically of much less importance in the chronic infectious diseases than in the acute, for they are not so often the immediate cause of death, unless, as is not uncommon, an acute nephritis becomes ingrafted upon the chronic. The onset of chronic renal complications is so insidious that it is rarely suspected early; prophylaxis should, however, be provided by giving particular attention to the bowel and to the general subsidiary excretory functions of the body in all long-standing infections.

The **diagnosis** must rest entirely on the usual manifestations

of renal disease—albuminuria, polyuria, casts, edema, high blood-pressure, nitrogen retention with diminished urea excretion, and the other cardinal symptoms of chronic nephritic lesions.

The **treatment** differs in no way from that employed in uncomplicating nephritis of the chronic type. Acute nephritis is, however, very likely to arise as a second complication, and may demand special attention.

Prognosis.—As a rule, renal involvement does not materially alter the immediate prognosis of chronic infectious disease, although it greatly diminishes the probability of ultimate complete recovery. Unlike the acute form, it rarely acts as the immediate cause of death except when it finally becomes acute.

SUPPURATIVE NEPHRITIS

Under this heading will be considered the processes generally classed under the heads of exudative pyelitis, pyonephrosis, and suppuration of the kidney. Tuberculosis, although coming properly under this head, will, because of its importance, be considered separately. This plan has been adopted for the reason that, clinically, the conditions are practically similar, the various changes that occur being often but different stages of the same general process.

Suppurative inflammation of the kidney may be brought about by four different methods of inoculation: first, by ascending infection from the lower urinary tract; second, by embolic infarction, as in general septicemia; third, by infection taking place in the course of what may be regarded as the normal excretion of bacteria by the urinary tract; and fourth, by the extension of suppurative processes into the kidney from without. Suppuration in the kidney may be localized in any portion of the organ, or it may be diffuse, the former condition being the more common.

In a large series of postmortems the writers found *ascending infection* to be by far the most frequent cause of suppuration. It may arise in any condition or disease in which infection of the lower portion of the urinary tract has taken place, as, for example, in the exudative urethritis of gonorrhea; in cystitis or suppurative disease of the ureters, and, finally, in pyelitis. As a rule, the infection travels upward from the urethra, prostate, or bladder, infecting the various portions of the excretory canal as it advances.

The mere presence of bacteria, regardless of the variety of organisms, in any of these portions of the urinary tract is not sufficient in itself to set up the process. Another and probably a more important factor, that of predisposition, must also be present. Thus pathogenic bacteria are often found in the urine under

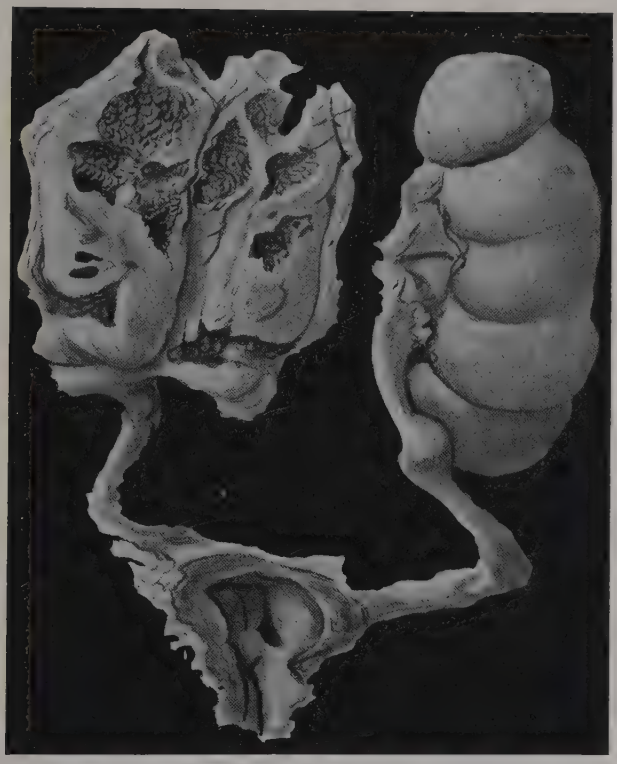


Fig. 74.—Double pyonephrosis (one-third natural size).

Originating from a primary cystitis and showing thickening of bladder wall, dilatation of both ureters, and extensive necrosis of renal tissue. Left kidney not opened. From a specimen in the museum of Carnegie Laboratory.

physiologic conditions, and, as a matter of fact, bacteria are often excreted by the urine in both pathologic and physiologic states without producing any local disease. This is particularly shown in regard to the colon bacillus, which is not uncommonly found in the urine, especially in constipation and in certain intestinal fermentations. Two such cases recently came under the care of the writers. In each case purgation caused a temporary disappearance of the colon bacillus from the urine, which reappeared

later. It is quite possible, as asserted by Nichols, of Montreal, that organisms so excreted may occasionally set up nephritis.

W. H. Thomson[1] has reported a series of cases in which colon infection of the kidney set up a diffuse nephritis manifested by the urinary findings of an active acute parenchymatous nephritis, but with symptoms of much less degree. Colon bacilli are found

Fig. 75.—Diffuse type of exudative or suppurative nephritis occurring in a pneumococcus septicemia. Complete necrosis and replacement of tubules is shown in the field: *a*, Malpighian body; *b*, infiltrating leukocytes.

in abundance in the urine of these cases, which, notwithstanding their very serious appearance, Thomson finds recover quite promptly under medication with urinary disinfectants, notably urotropin. We have since had frequent occasions to verify Thompson's statements in regard to the rôle which the colon bacillus may thus play, but while the prognosis is far better in those

[1] "New York Medical Record," March 21, 1908.

cases than in most others of urinary infection, a favorable result is by no means to be definitely expected, for a general septicemia frequently appears in the condition or a chronic interstitial nephritis.

The most frequent factor predisposing in the development of suppurative nephritis is hydronephrosis. This may be induced by any cause whatever, as when abnormal retention occurs, as in alcoholic stupor or other comatose conditions, in obstruction to the urinary passages, as from impaction of a calculus, in enlarged prostate, urethral stricture, and the like. In all these conditions, when the urine is retained until abnormal distention of the bladder, ureters, and renal pelvis takes place, the integrity of the epithelial lining of these cavities becomes so much impaired that, if bacteria are present in the urine, the hydronephrosis is very prone to be converted into a pyonephrosis. Pyonephrosis may, however, be excited by a mechanic irritant; thus the excretion of highly irritating urine, the presence of renal calculi, or other similar conditions may act as factors in its production. From this it must not, however, be concluded that every case of pyelitis or even of pyonephrosis leads to suppurative nephritis. Recent observations made with the aid of the cystoscope have demonstrated that these conditions frequently exist and undergo spontaneous cure, or are relieved by catheterization and flushing of the ureters and pelvis.

When extension into the body of the kidney takes place from these ascending infections, it occurs through the secretory tubes of the medulla. In these cases the pyramids may be soon transformed into abscess cavities that retain the pyramidal shape and are continuous with the distended pelvis of the kidney. This process may continue until the entire medulla of the kidney is involved or until the cortex itself has become gradually necrosed and the entire kidney transformed into an abscess cavity inclosed in the thickened capsule, which, in most cases, acts as a limiting membrane to the suppurative process. If drainage is good and if but one organ is involved, as is frequently the case, the process may gradually be checked and very slight constitutional disturbance may result. The condition may often be unsuspected until a urinary examination is made, which will reveal the constant presence of pus in abundant quantities. It is remarkable, how-

ever, to what a limited degree urinary excretion is hampered, even when both kidneys are involved; in these cases uremia is very rare, and a double pyonephrosis has been known to exist for years without interfering with the business activity and often with but little inconvenience to the patient. Apparently, such a result is dependent on the amount of drainage and, to a certain extent, on the bacterial character of the inflammation.

Embolic infarction of the kidney is rather frequent, owing to the numerous terminal arterioles that are given off to the cortical portions of the kidney, and which are particularly prone to be the seat of emboli. Embolic infarctions occur most frequently in pyemia or in septicemia. In most cases the infarct precedes suppuration, the latter process being, however, greatly favored by the necrotic material present in the obstructed area. In a considerable number of cases, particularly in malignant endocarditis and puerperal sepsis, suppuration seems to occur independently of the existence of an infarct.

Suppurative nephritis due to the presence of emboli often runs a very mild course. Not infrequently these localized abscesses of the kidney become encapsulated and give rise to but slight if any clinical manifestation; ordinarily, unless the abscess is very large, or if, as is unlikely, suppuration spreads, pyuria is absent. In short, abscess formation in the kidney does not display so marked a tendency toward extension or destruction of tissue as is the case with similar processes elsewhere. In a few cases these cavities may drain through one of the large tubules; when this occurs, pus may be found in small quantities in the urine. As a rule, however, in the writers' experience, the condition commonly goes unsuspected, except in a small number of cases in which the abscess is sufficiently large to present a palpable tumor or severe pain is present.

Infection due to the presence of *pathogenic organisms in the urine* is not commonly mentioned as a cause of suppuration, but it is, nevertheless, one of the possible factors in its production. In constipation, in general septic conditions, in infective icterus, and in many other pathologic states bacteria are expelled from the body with the urine. Ordinarily, this takes place without

serious consequences to the kidney, but instances undoubtedly occur in which bacteria are brought to the organ, and probably because of some mechanic state or a lowered resistance of the renal tissue, an inflammatory process is set up. Thus areas of suppuration are occasionally found in the kidney when no general sepsis has existed and when ascending infection may, with reasonable certainty, be excluded. Such cases usually follow the same course as embolic infarction, although occasionally, as in Weil's disease, diffuse suppurative nephritis may arise.

Suppurative nephritis originating from *extension* of the process into the kidney from outside sources is somewhat uncommon, except as a sequel to traumatism of the kidney; it is quite rare even in cases of perinephritic suppuration. Occurring under these conditions it resembles perinephritic abscess, and is perhaps best described under that head.

Perinephritic suppuration may arise as the result of rupture of a renal abscess into the perinephritic tissues, or as an extension of a diffuse suppuration of the kidney into this tissue. These are among the more infrequent causes, although rupture of a pelvic abscess, particularly when pelvic calculi are present, is relatively frequent. Most commonly it follows injuries received in this region or as the result of extension of suppuration, as in spinal caries or from subdiaphragmatic drainage of an empyema. Most frequently, perhaps, it follows ulceration and perforation of the intestine, generally of some portion of the colon or appendix. It may also arise in marasmic conditions, particularly in children, and in cases of prolonged illness, where a generally depressed state of the tissues, especially of the fatty variety, is present.

As a general rule, the bacteria found in perinephritic suppurations are not of the most virulent type. The colon and the proteus bacillus are among those most frequently observed, although, of course, any member of the intestinal group may be present. As a consequence the pus evacuated from these abscesses gives off a very foul odor, and yet may remain in the body for a long time without producing sepsis or marked general symptoms.

Perinephritic abscesses may drain in various directions, this depending largely on the position habitually assumed by the

patient during the course of the disease. The pus may burrow upward into the pleural cavity, producing an empyema on the same or on the opposite side. The abscess may rupture into the peritoneal cavity, or the pus may even work its way across the retroperitoneal tissues to the same region on the opposite side, double perinephritic abscess being by no means rare. Probably one of the most common routes of extension is along the sheath of the psoas muscle, finally presenting in the groin. Another course, which renders attack easy, is for the abscess to point through the muscle of the back or side.

Diagnosis.—Unless pus can be demonstrated in the urine collected before bladder contamination has been possible, the diagnosis of suppurative nephritis is, as has been stated previously, very difficult and often impossible. When pus is present, it may be found in but small amount, particularly in the diffuse forms; when it escapes from a localized abscess, it may be present at one time and absent at another. Blood is rarely seen except in the early stages of traumatic cases, and casts may or may not be present; pus-casts are occasionally found, however, even when free pus-cells seem to exist only in very small numbers. The urine may be either acid or alkaline in reaction, this depending largely on the nature of the organisms present; usually, when the infection is an ascending one, it is alkaline. As a rule, there is no change in the amount of urine secreted, and at times it may contain particles of necrotic renal tissue, the nature of which may be recognized under the microscope.

When the infection has been ascending, the diagnosis is, as a rule, greatly facilitated by the history of the case, by the presence of urethritis or cystitis, or by the discovery of an obstruction to the ureter or to the outflow from the bladder. It will occasionally be found, strangely enough, that no cystitis or inflammatory disease of the lower urinary passages exists (having undergone cure), whereas the pyonephrosis or pyelitis that occurred secondarily is still present. From this it will be seen that a normal condition of the lower urinary passages does not exclude the possibility of these channels having been the original seat of infection.

Although the condition of the urine is by far our most important aid in the diagnosis of this disease, other factors are to be considered. For example, fever may be present, either with or without the occurrence of pyuria; on the other hand, this appears to be largely dependent on the bacterial nature of the process; thus extensive renal suppuration, usually of a more or less chronic type, has frequently been found without any hyperpyrexia occurring. A more constant finding is a polynuclear leukocytosis, although this may also be absent, and, more particularly, in the very cases in which pyrexia is likewise absent.

There are no symptoms that are characteristic of renal suppuration other than those common to a suppurative processs occurring

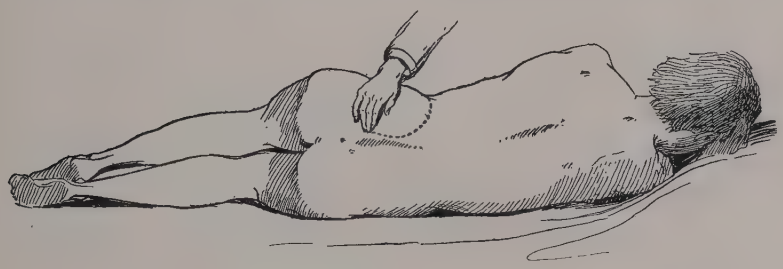


Fig. 76.—Method of expressing pus from kidney pelvis into the bladder.

elsewhere in the body. Except when the urinary findings indicate the probable seat of the process, or the somewhat unusual symptoms of renal tumor or fluctuation in the kidney region are present, a diagnosis is not generally possible. Occasionally, however, the patient will complain of severe pain in the renal region, and while this is not of much value in the diagnosis, it is a point to be considered.

The tendency for a patient to draw up the leg on the affected side is somewhat indicative of pus either in or around the kidney. Catheterization of the ureters furnishes one of the surest, if not the safest, means of diagnosing pus within the kidney. Some experience is necessary, however, in performing this operation, and in interpreting the findings from it correctly, for the passage of the catheter itself will often cause enough irritation to render

the urine slightly cloudy. Microscopically, a few pus-cells may be found, but this alone does not necessarily indicate that a suppurative nephritis is present. In small kidney abscesses, in which there is good drainage, it should be remembered, spontaneous cure often results; when, therefore, a small quantity of

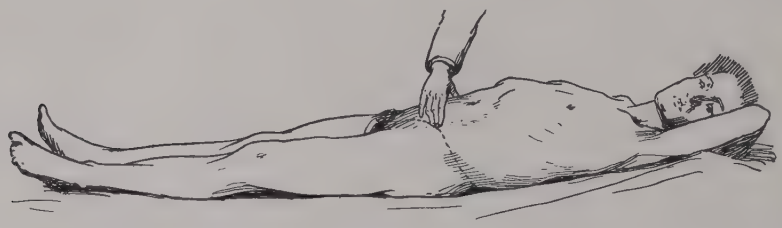


Fig. 77.—Method of expressing pus from the kidney pelvis into the bladder, continuation of figure 66.

true pus is found in the urine obtained by ureter catheterization, this is not necessarily an indication for the performance of

Fig. 78.—Vibratory method of expressing or massaging pus from the renal pelvis into the bladder.

nephrectomy, or even of lavage of the pelvis of the kidney by means of the ureter catheter.

A valuable method, and one coming into more general use, for diagnosing the presence of pus in the kidney is that of making an examination of the urine before and after performing massage of the kidney region and along the course of the ureter. The writers' attention was very recently directed to the value of this diagnostic measure by the House Staff at the City Hospital of New York. In one case the massage forced so large an amount of pus from the kidney into the bladder that the gross appearance of the urine was materially altered. This, together with the occurrence of the general symptoms of sepsis, was considered evidence

abscess of the kidney. If this method demonstrates the presence of a considerable amount of pus, nephrectomy is, as a rule, indicated. This method as a means of diagnosis has been advocated by Giordano, of Venice.[1] This observer places the patient at rest, empties the bladder, performs massages over the kidney and along the course of the ureter, and then collects the urine. After this he washes out the bladder, performs massage of the other side, and collects the urine again. When the urine of one side is bloody, he considers this an indication of the presence of renal calculus. G. Nicholich, another Italian observer, advocates the leaving of a catheter in the previously washed-out bladder and massaging first one side, and then the other.

As has previously been mentioned, the writers consider this massage or the making of pressure over the kidney and along the course of the ureter as one of the most valuable diagnostic aids at our command, and recommend its use not only for the purpose of demonstrating the presence or absence of pus in the kidney, but as furnishing evidence of the presence of renal calculi, besides giving general information as to the conditions of these organs.

Treatment.—Ordinarily the treatment of an abscess in or around the kidney is essentially surgical and consists in drainage or the performance of either nephrotomy or nephrectomy; operations which will be described in detail further on (p. 288). Cases, however, occur in which surgical intervention either is inadvisable or is not permitted; these must be put on a strict hygienic and dietetic régime and symptomatic and medical measures may be used to relieve distress or to minimize the effects of disease. Urotropin used carefully but in full doses apparently has given very satisfactory results in certain of these cases, and the use of vaccines, either autogenous or stock, is thoroughly justified after bacterial examination has demonstrated the nature of the organisms present.

[1] "La Semaine Méd.," March, 30, 1094.

CHAPTER IX

BRIGHT'S DISEASE

THE PATHOLOGY OF BRIGHT'S DISEASE

There is no more difficult problem in medicine than to make a comprehensive and accurate determination, from the clinical aspects, of the existence of Bright's disease, and to tell, from these, the precise lesions that occur in the kidney, or vice versâ. While the recent researches in regard to kidney disturbances have thrown very much light on these diseases, it still remains most difficult to determine antemortem from all the findings in any case what the postmortem renal lesions will be found to be. Not uncommonly cases that appeared clinically to be examples of typical acute nephritis are shown at autopsy to have been but an acute exacerbation of a chronic or subacute one. On the other hand, cases running a slow and relatively mild course, typical of the chronic form of the disease, may be found to be due to purely acute and active lesions. While Cabot, in his conclusions, may take too extreme a view when he declares that we can tell nothing of the character of the lesion from the clinical aspects presented and from an examination of the urine, yet those who have followed cases from onset to autopsy cannot but agree with him in the main. It must be acknowledged that to Cabot, perhaps more than to any other observer, is due the credit for an honest realization of the difficulties of making an exact diagnosis in inflammatory and degenerative lesions of the kidney.

When accurate methods for examining the urine were first introduced it seemed as if through them some positive information might be gained of renal disease. In the main this is true, although it must be said that no broad-minded clinician now feels that he can rely absolutely on even this aid in more than the "average" case. Recognizing fully the tremendous advantage which the chemical examinations of the blood have given us, together with the enlightening data of sphygmomanometry and

of the tests for renal permeability, we cannot feel that even the great strides of recent study and experience have materially changed this statement. Certainly Cabot's statistics and those of later observers in regard to this matter must lead to the adoption of even a more pessimistic view of absolute anatomic diagnosis in this disease.

For this reason the writers have long ago abandoned the attempt to make an exact diagnosis in regard to the anatomic condition of the kidney from the clinical findings or symptoms, and rely chiefly on the determination of the physiologic possibilities, which, after all, are the more important, since on these, and not on the exact anatomic changes, rests the hope of effecting reparation and recovery of function. Nevertheless, the study of the pathologic anatomy of the kidney in Bright's disease is most important, particularly in considering the treatment of mild or early cases, and in attempts at prophylaxis. It is necessary, besides, to establish a basis of definite anatomic lesions on which to erect our superstructure of symptomatology, and on which to formulate our course of treatment. We shall not feel that the newer methods of study and diagnosis, as from chemical investigation of the blood, are wholly satisfactory and conclusive, until these make it possible to definitely prognose the anatomic pictures found at autopsy. We are still far from such success.

All kidney lesions in Bright's disease are separable theoretically, practically, and anatomically into two large classes—(1) Those in which true inflammatory lesions are present in the kidney tissue; (2) those characterized by degenerative changes in the parenchyma. In adopting this simple classification it must be borne in mind, of course, that, though it may exist theoretically, one never sees a pure type of either class, and the division holds only in that in most cases either degenerative or inflammatory lesions predominate.

A further subdivision into acute and chronic is usually possible both clinically and anatomically, and in this discussion an attempt will be made to adhere as closely as possible to this simple classification, believing it to be that most useful to the study and management of cases of Bright's disease, and most helpful to a proper understanding of the disease.

Acute Bright's disease may be due to any agent or factor that is productive either of acute inflammatory foci or of active parenchymatous degeneration in the substance of the kidney. It is hardly necessary to state that when the inflammatory process amounts to actual suppuration, it should not be considered as Bright's disease, but as a suppurative nephritis.

Among the agents most commonly productive of such inflammatory lesions in the substance of the kidney must be mentioned those vascular disturbances that give rise to sudden hyperemic conditions of the organs; this may be, in a certain number of cases, of neural origin, or it may be due to those vague, but none the less important, derangements of the vascular supply that follow exposure to excessive cold, heat, or physical or mental strain. Although the complete theoretic understanding of these

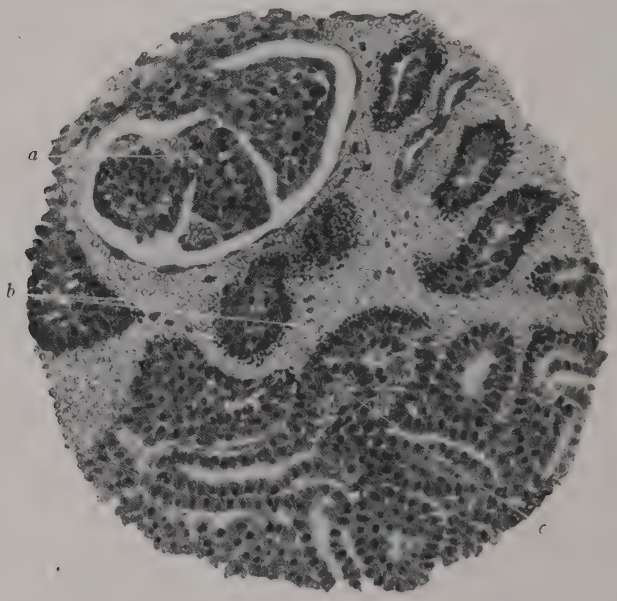


Fig. 79.—Acute hemorrhagic nephritis, occurring in a case of scarlet fever. The urine contained large quantities of blood: *a*, Malpighian body; *b*, extensive interstitial hemorrhage causing isolation of tubules; *c*, hemorrhage into lumen of convoluted tubule.

factors may be unsatisfactory, clinical experience has shown beyond doubt that they cause acute nephritis.

Sudden checking of the function of other excretory organs, as the skin or bowel, with the resulting hyperemia, may be followed

—and, in fact, often is followed—by the development of inflammatory changes in the renal tissue, in this way setting up a true acute nephritis. Irritants circulating in the blood, such as the metallic poisons, alcohol, spices, and condiments, may also act in a similar manner. More frequently we find that poisons generated in the course of the various infectious processes, and brought to the kidney for excretion, act as inflammatory excitants, although in most cases these agents affect chiefly the renal epithelium, causing degenerative disease and resulting in that type of nephritis which we are attempting to separate from the true inflammatory form. More often than is generally conceded, metabolic substances that result from the abnormal breaking up of normal food products or tissue, or those that follow from the natural disintegration of abnormal metabolic substances,—materials exciting inflammatory reactions,—are brought to the kidney. There can be little doubt but that many of the apparently idiopathic cases of nephritis are really brought about in this manner, and it becomes the duty of the physician to study the metabolic functions of his patient as fully as possible. By making frequent examinations of the urine and the feces and with close attention to the digestive functions, metabolic disturbance may usually be detected early and corrected, thus preventing the onset of renal complications.

The actual changes in the kidney substance in this inflammatory type of Bright's disease vary greatly according to virulence and the rapidity of action of the etiologic agent, and doubtless according to the natural resistance offered by the renal tissue and also to a certain degree on the anatomic portion of the kidney chiefly affected, as the glomeruli or the tubules, etc.

In general it may be stated that renal lesions may manifest all the types of inflammation seen elsewhere in the body. In a certain number of cases, particularly in those of sudden onset, intense hyperemia develops, often with diapedesis of the white and red blood-corpuscles, which may then appear in the urine. Naturally, cell-infiltration is found to be most marked about the blood-vessels, and particularly in the cortex of the organs, where the capillary distribution is most abundant. Proliferation of the connective-tissue cells in the adventitia of the larger vessels

and the interstitium of the kidney tissue follows, and areas of small round-cell infiltration appear about the vessels and lymphatics. Serum may be thrown out in abundance, and at post-mortem examination the cut sections of many such kidneys drip serum in great quantities. Associated with these changes more or less degeneration and desquamation of renal epithelium take place, and these fragmented cells, together with serum and blood, collect in the tubules and are washed out as casts of various types.

The vessels remain hyperemic throughout, and even gross inspection of the organ is sufficient to demonstrate the engorged capillaries.

In this type of nephritis healing presupposes, of course, the removal of the etiologic causes, the reëstablishment of normal circulation, absorption, by the blood and lymph, of the liquid portions of the inflammatory exudate, and the disintegration of the extravasated blood-cells, broken-down epithelium, and connective tissue, which may either be carried off in the urine or be picked up by phagocytic leukocytes and endothelial cells and then may be taken away by the lymph-stream. With the removal of the exciting factors and of the inflammatory exudate restitution of the desquamated epithelium by a multiplication of the remaining cells readily takes place, and the lesions of the urinary tubes are quickly repaired. Quite another and more serious matter is the disposition of the newly formed connective-tissue cells, for, with the growth of this tissue, new blood-vessels have developed and a definite structure has been built up that is best described, perhaps, as a type of granulation tissue. Assuming that the acute inflammation has entirely subsided, either this newly formed tissue must break down and become absorbed,—a result that the writers believe but rarely takes place,—or it must pass on to the formation of adult, that is, scar, tissue, with its well-known tendency to contraction. In this manner the chronic sclerotic type of nephritis may readily follow the acute disease.

It has appeared impracticable to attempt the still further division of this form of nephritis into subclasses, since the type in

each case depends not on essential alterations in the cause or nature of the disease, but rather on the form or degree to which the inflammatory process progresses.

It is notably, if not exclusively, in this type of case, especially where the glomeruli are mostly involved, that increase in arterial tension develops, and concomitant with it the retention of nitrogenous bodies in the blood; usually sooner or later sodium chlorid and urea also fail to be normally excreted, and either gather in the tissues or in the body fluids, causing or favoring edema and other marked circulatory changes. Chase, Halsey, and others of their school insist that the retention of uric acid in the blood is among the very earliest tendencies in these cases. It is certainly true that the blood uric acid content is high in most of these instances, but we are not prepared to fully adopt their viewpoint in this regard. Fully developed cases of this type are unable to concentrate their urine.

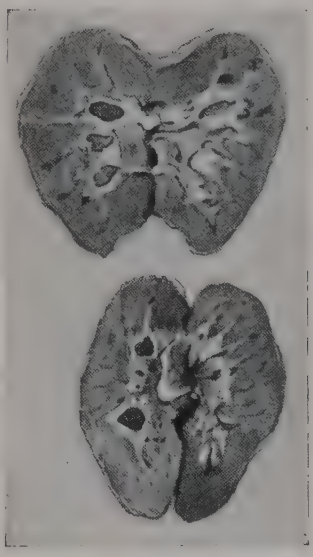


Fig. 80.—Chronic interstitial nephritis. (One-half natural size.) Both organs from same subject. Case of chronic lead-poisoning. Specimens in museum of Carnegie Laboratory.

The second type of acute nephritis, or Bright's disease, according to our classification, comprises those cases that are chiefly typified not by inflammatory, but by degenerative alterations; although, as has previously been stated, these two processes are usually associated to a greater or less degree, and classification is only possible from the predominating lesion. The degenerative type of nephritis occurs most commonly as a result of toxemia, particularly that resulting from such processes as diphtheria, sepsis, and as in certain cases of typhoid fever. It occurs also, and even more commonly than the inflammatory type, in cases of metabolic disturbances. The process is often ushered in without exhibiting the slightest inflammatory manifestations symp-

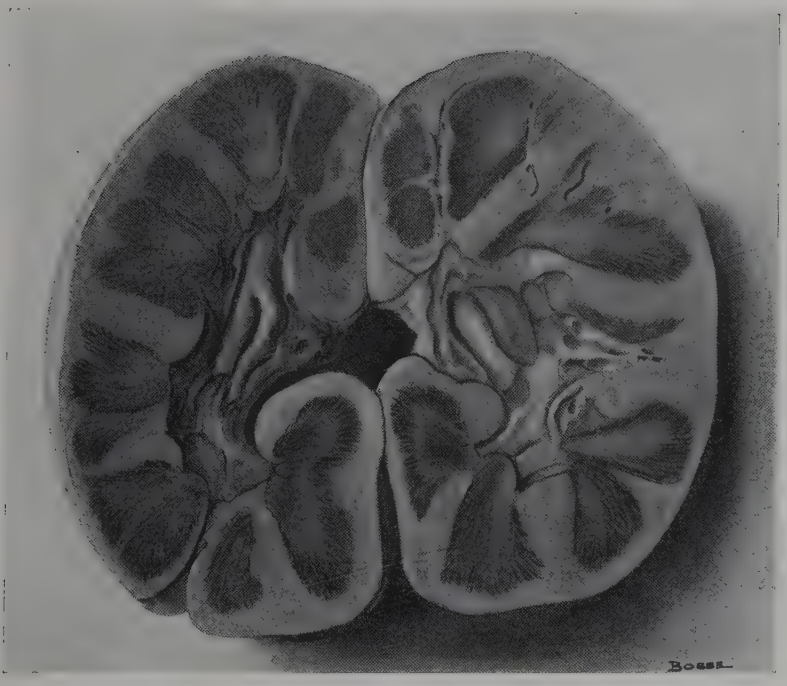
tomatically or in the renal tissue, and solely by the degenerative changes in the epithelium; almost always, however, inflammatory changes eventually follow to some extent.

As is naturally to be expected, the disease affects particularly the cells of the convoluted tubules, and is first manifested by

Fig. 81.—Chronic interstitial nephritis, showing adherence of capsule and roughened surface. Natural size.

evidences, in these cells, of an acute parenchymatous or albuminous, later associated with a fatty, degeneration. The cytoplasm of the cells, and, in more severe instances, the nucleus as well, becomes turbid and swollen from the transformation of the normal cell-substances into lower albuminous granules. When the process becomes sufficiently marked, the cell begins to disintegrate, and fragments are thrown off into the urine; or, in a more active process, the entire cell may thus be desquamated, and if fragments appear in abundance in the urine, unaccompanied by blood-cells or other inflammatory products, this is more or less diagnostic of this form of renal disease. Casts form, as in the first variety, for associated with the degenerative changes in the renal cells is a similar process affecting the endothelium of the capillaries, and lymphatics.

PLATE VII



Large white kidney. (Two-thirds natural size.) (From a specimen in the Museum of Carnegie Laboratory.)

Changes in the connective tissues arise in this form only as complications, and the healing process is so much simpler that the cases are quite distinctly differentiated from the former class by their relatively rapid and permanent recovery, under proper conditions. The healing process consists simply in the complete

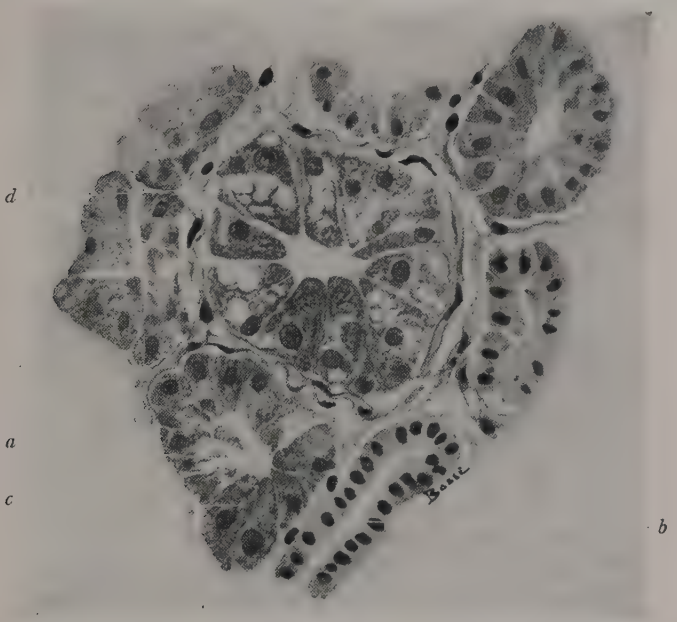


Fig. 82.—Combined parenchymatous and fatty degeneration of kidney, from a case of puerperal eclampsia: *a*, Convoluted tubules showing extensive degeneration; *b*, collecting tubules; *c*, cells showing profound parenchymatous degeneration; *d*, oil globules in cytoplasm of degenerated cells.

desquamation of those cells that are too much diseased to permit restitution to take place, and the replacement of these discarded cells by others that arise by cell division from the remaining and relatively normal cells. This process is readily brought about in most cases, and may result in such complete repair that the organs become relatively normal again. This rarely or never occurs in cases associated with true inflammatory alterations, especially where the glomeruli have been seriously compromised.

When more or less complete destruction of the parenchyma has taken place, new tubules, supporting tissue, and even glomeruli may all be re-formed in young tissues; the same manner of repair

may also take place, though in lesser degree, in the inflammatory forms. It must, however, be repeated that pure instances of the degenerative types of nephritis are rare.

As a rule, the **chronic inflammatory variety of nephritis** is a sequel to the acute disease of the same type, although it may follow the degenerative form, particularly when it is long continued and associated with extensive destruction of tissue. In this chronic type of inflammatory nephritis several classifications

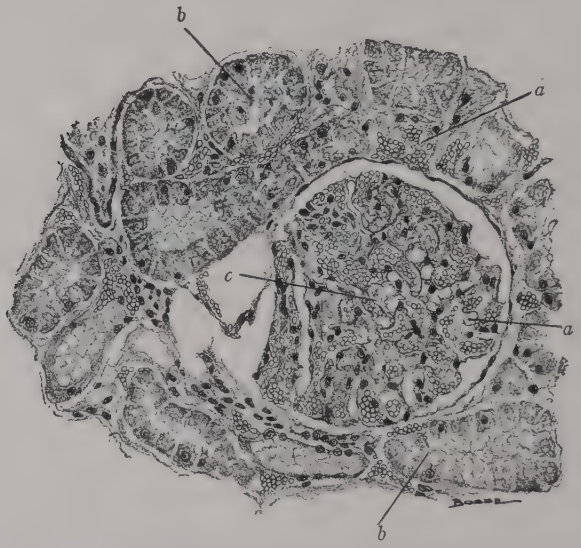


Fig. 83.—Profound degree of parenchymatous degeneration of the kidney occurring in a case of toxic lobar pneumonia: *a*, *a*, Congested capillaries; *b*, *b*, convoluted tubules showing advanced parenchymatous degeneration with necrosis and desquamation of the epithelium; *c*, injected glomerulus.

are commonly made, the organ being denominated as the large red kidney, the small sclerotic kidney, and so on. It is the writers' belief that it is absolutely impossible to differentiate these types clinically, nor does the new blood chemical changes assist in this, and since they really represent but modifications of the same pathologic process, a minute classification according to mere gradations of the identical disease process seems unnecessary. When the disease is characterized by active hyperplasia of the interstitial tissue, often associated, it is true, with parenchymatous degeneration and hyperplasia as well, the size of the organ increases, this increase being chiefly due to the pro-

duction of granulation tissue in the organ; if, on the other hand, this hyperplastic process is less active, the newly formed tissue is allowed to develop until it assumes a more adult type, becoming, namely, cicatricial tissue, and the small or sclerotic form of kidney results. In either case the functionating epithelium and the vessels are compressed, and both venous and lymphatic return flow is impeded. This greatly diminishes the functional possi-

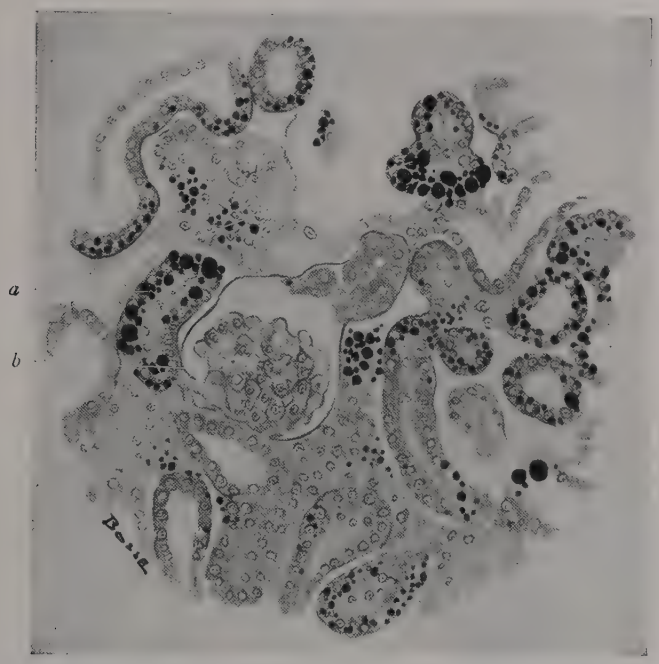


Fig. 84.—Kidney of rat showing profound fatty degeneration following experimental arsenical poisoning; section stained with osmic acid: *a*, Convoluted tubules with fat globules stained black; *b*, Malpighian body.

bilities of the organs, and the excretory process, in so far as the kidneys are concerned, becomes more nearly a simple filtration or osmosis, as is shown by the chemic nature of the urine. An increase in blood-pressure at first with adequate and, finally, with a failing pulse-pressure appears, nitrogen retention becomes marked, and it is impossible to bring about urine concentration by either dietetic, fluid intake, or medicinal means. The overgrowth of connective tissue chiefly works harm by effecting direct compres-

sion and consequent atrophy of the secreting tubes, and notably, according to Volhart and Fow, of the glomeruli. Occasionally the newly formed tissue chiefly compresses the collecting tubules, and, as continued secretion takes place, the tube above the point of stricture becomes dilated and the formation of cysts, often of considerable size, and closely simulating those of congenital cystic kidney, occurs.

It is obvious that the constantly progressive hyperplasia of the connective tissue, with or without resulting contraction, causes serious inhibition of the renal function, even though the interstitial hyperplasia is occasionally associated with parenchymatous proliferation in limited degree. It is, therefore, found that in this disease compensatory excretion is carried on by the other excre-

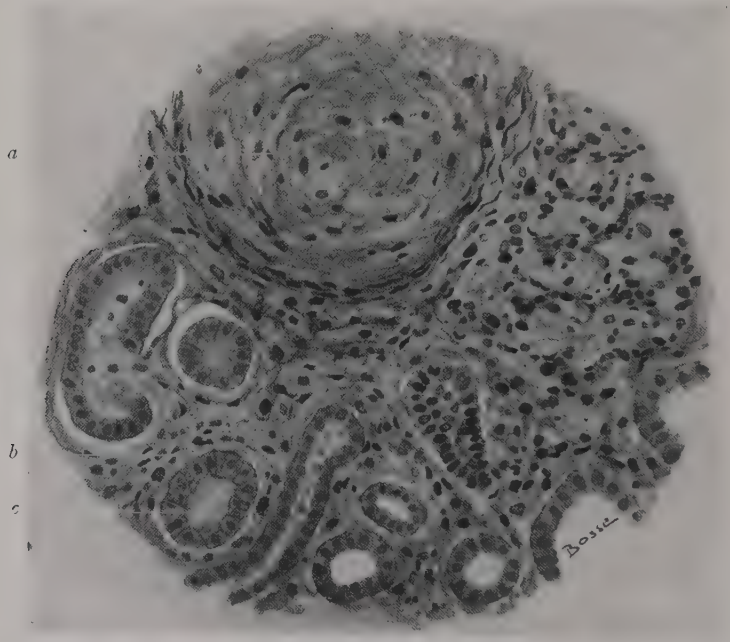


Fig. 85.—Chronic interstitial nephritis, from a case of chronic alcoholism: *a*, Glomerulus replaced by hyperplastic connective tissue; *b*, diffuse hyperplasia of stroma; *c*, compressed and atrophied tubules filled by degenerated epithelial cells.

tory organs, particularly by the skin and bowel, so it frequently happens that when either of these also become diseased, the additional work thrown on the crippled kidneys may set up an acute

hyperemia and an exacerbation of the inflammatory process, a common termination to this form of renal disease.

It is unusual to find the **chronic degenerative** type of Bright's disease entirely uncomplicated by inflammatory lesions, and the presence or absence of these changes determine, to a large degree, the activity of the morbid process. When the generation of new parenchyma cells keeps pace with their destruction, and the organs are still able to handle satisfactorily the solids of the urine, notably the uric acid, urea, and sodium chlorid, the process may be continued indefinitely until some other factor arises that interferes with this compensation, resulting commonly in acute outbreaks of nephritis or in uremia. One can readily understand how, in nearly pure cases of this kind, the disease may run a prolonged course, albumin being constantly found in the urine, and yet the kidney may be able to carry on its functions in a relatively normal manner. As a rule, unless inflammatory changes intervene,

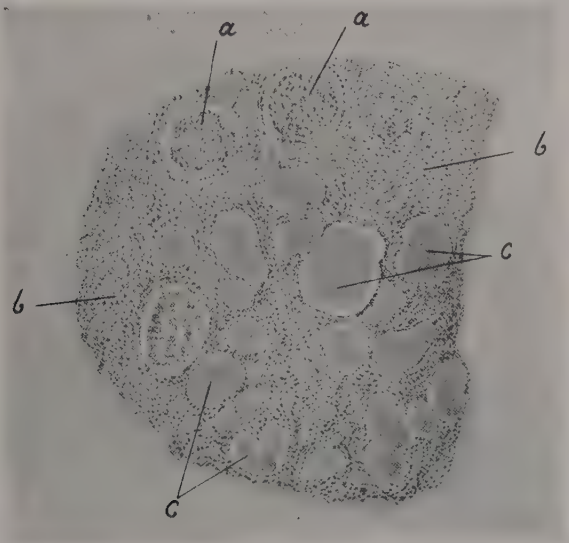


Fig. 86.—Chronic diffuse nephritis, showing diffuse production of fibrous connective tissue with replacement of the glomeruli and many large hyaline casts in the tubules: *a*, *a*, Glomeruli showing fibroid substitution; *b*, *b*, diffuse growth of connective tissue; *c*, *c*, hyaline casts in tubules.

these cases do not terminate fatally; patients so afflicted may pass through infectious diseases and other similar processes quite as successfully as those whose kidneys are supposedly normal.

Although in many cases the kidney manifestations dominate the disease-picture, it is surprising to find how relatively rare it is for Bright's disease to appear as an independent process. As has been shown elsewhere, the condition commonly originates as a result of some other disease process, and in its chronic as well as in its acute form the most important guide to its proper understanding and treatment lies, not in the consideration of the kidneys alone, but in understanding thoroughly the entire system and the workings of quite independent viscera. Thus nearly all cases of chronic, and many of acute, Bright's disease are associated with serious disturbances of the vascular apparatus. So intimately are these systems functionally associated that we frequently now speak of certain forms of nephritis as vascular renal or cardiovascular renal complexes. More or less arteriosclerosis is present concomitantly, and in the inflammatory forms of the disease particularly this is manifested by an increase in the general blood-pressure, a fact that is well recognized of considerable diagnostic importance. This in turn leads to cardiac hypertrophy, myocarditis, and eventually to cardiac dilatation, incompetence, and secondary circulatory changes in the brain, liver, and gastro-intestinal tract—and, finally, in practically every vital organ of the body. It is often most difficult to determine in any case the order or sequence of these changes. Not infrequently it seems that the renal lesions, although dominating the case, are but secondary, for example, to arteriosclerosis, myocarditis, or to valvular lesions of the heart that originally led to renal congestion. This but emphasizes the importance of considering each case individually, and of treating not the renal lesion, but the patient.

THE SYMPTOMS, DIAGNOSIS, COURSE, AND PROGNOSIS OF BRIGHT'S DISEASE

In *acute Bright's disease* the onset is frequently sudden. The patient may first observe that the amount of urine is diminished, or that the ankles, wrists, or face become swollen at times. Not uncommonly the first observed symptom, particularly in the degenerative type, is an enlarged abdomen, due to ascites. In a small number of cases the disease is inaugurated with a chill, and may be characterized throughout the early stages by a mild pyrexia; this is

particularly true in the inflammatory form. The pulse is rapid and hard, and the blood pressure is considerably raised, although this is not so constant in the cases in which the changes are chiefly of a degenerative nature. Sudden dilatation of the heart may follow this raising of the blood-pressure, particularly when myocarditis has preëxisted. As a rule, the dropsy is somewhat slight, in the acute cases, and, instead of being general, it is oftentimes curiously localized to certain areas. In the beginning of the disease perspiration is generally checked and the skin becomes harsh and dry. Occasionally the onset is early manifested by the occurrence of uremia, and active maniacal symptoms or convulsions may develop, to be succeeded by a somnolent or comatose state. These uremic symptoms are particularly frequent in acute exacerbations of chronic cases.

The amount of urine is greatly diminished, as a rule, or it may become entirely suppressed. It is usually dark in color, often smoky from the presence of blood-pigment, and turbid with phosphates, blood, casts, and epithelial cells. The specific gravity is generally high, although, on account of the diminution in the amount secreted, the total solids so eliminated are also diminished. Occasionally, however, the amount of urea present is normal. Albumin generally appears in large amounts, and its presence may cause a lowering of the specific gravity. The quantity is no indication of the gravity of the case. In some of these cases the blood nitrogen is markedly increased, but we believe only in those instances where the glomeruli are extensively involved, in which instances usually the urine is not of high, but of persistently low, specific gravity.

In some cases, particularly those in which inflammatory lesions predominate, the onset is marked by severe pains in the back, which may be mistaken for those of a myalgia. Persistent nausea or vomiting and occasional diarrhea are not uncommon premonitory or initial symptoms.

Anemia and dyspnea develop early in the course of the disease. The former appears to be due not so much to the actual loss of blood, as to a probable hemolysis taking place in the blood-stream as a result of excrementitious substances which are circulating in this tissue. This may in some cases give rise to a

pronounced hemoglobinuria. The dyspnea is probably due to a disturbed CO_2 coefficient, or possibly, as Fisher asserts, to an acidosis.

The course of the disease depends largely on the general condition of the patient, and, naturally, on the degree of the process, and particularly on the amount of urine excreted, the amount of retained blood nitrogen, and on the activity of the subsidiary excretory organs.

The disease is easily diagnosed, but it is not so easy to decide whether the condition is a primary or a secondary manifestation. This is manifestly a most important matter, since if the process be a secondary one, relief or removal of the cause becomes the most essential and primary factors in the management of the case.

The symptoms may be confusing and the diagnosis of *chronic Bright's disease* is made with much greater difficulty. The old theory that the chemic and microscopic examination of the urine is a safe guide has now become to a great extent obsolete, nor do blood studies always clarify the situation as they might be expected to do. Although it is possible, within proper limitations, to draw valuable information from such aids as frequent qualitative and quantitative examinations of the urine and from the phenolphthalein or Mosenthal tests as to permeability, and from the use of the sphygmomanometer, still absolute diagnostic evidence may be entirely wanting in some cases. The early diagnosis of so insidious a disease as diffuse interstitial nephritis, which causes thousands of deaths annually, and which, according to statistics, is increasing, is a feature the importance of which the profession is only now beginning to realize, and the difficulty and uncertainty of early diagnoses in these insidious types must be more fully appreciated. More than any other factor, however, in these obscure cases studies of the blood chemistry aid us. Recognized early, either as a primary condition or as the result of some preexisting lesion of the kidney or other viscera, much can be done toward arresting the disease and prolonging the life and usefulness of the individual.

The part played by heredity, as shown by the family history of the patient, may or may not be of importance. Gout seems to be hereditary in some families, and is, of course, a frequent

causative factor in the production of chronic nephritis. This has been newly affirmed by studies of the blood uric acid. Inherited nervous weakness, to use a general term, seems to predispose to the development of an early interstitial nephritis, owing to the intimate relationship existing between the nervous system and the kidneys. The offspring of neurasthenic parents, it might be predicted, would have kidneys that would not withstand the strain easily borne by those of more fortunate nervous inheritance.

More important than the family history is the personal record of the patient—a history of the occurrence and course of infectious or venereal diseases, of the general habits of life, and of excesses in drinking, smoking, or eating. Of great importance in this respect —since it is, the writers believe, a common cause of nephritis—is the presence of nerve-strain. It seems to be the general opinion among the profession as well as among the laity that many far-advanced cases of Bright's disease remained unrecognized until a very short time before death, the patients suffering no discomfort and complaining of no symptoms. This has not been borne out by the writers' clinical experience, which shows that the cases of chronic nephritis that have not presented, long before death occurred, symptoms of ill health apparent to an intelligent observer, are few indeed. Headache is, of course, a common symptom; it may be of any variety, the only one at all typical being the intense general orbital distress occasionally met in patients with acute Bright's disease and in the later stages of the chronic form. The ophthalmic manifestations have been discussed in a previous chapter. Indigestion of various forms is very commonly complained of. Sudden attacks of vertigo or of dyspnea, without sufficient accompanying vigorous physical exercise to justify its occurrence, are suspicious symptoms. The symptoms of so-called cardiac asthma are almost pathognomonic of a serious renal concondition, especially if unassociated with cardiac arhythmias, hypertrophy, or other explanatory lesions of the heart. Arteriosclerosis is, in its mere presence, an almost certain sign of more or less nephritic disease, especially if it be of a diffuse form.

The condition of the hair, which is dry and brittle, and the state of the skin, which may be the seat of the more common forms of eruption, such as the many varieties of eczema, are

recognized as being sometimes associated with forms of renal insufficiency. Pains in the back are, by the laity, often attributed to kidney lesions, and are of such common occurrence in certain cases as to have, the writers believe, a diagnostic significance, although oftentimes entirely wanting. Edema of one or both of the lower extremities, transitory, it may be, can be detected on examination; or, when not discovered, a history of its previous existence may be given.

The estimate of the solids of the twenty-four-hour urine is of considerable value. If this is found permanently below 70 grams daily, and if no other explanation for it exists,—as an unusual diet or a deficient amount of exercise,—a suspicion of interstitial nephritis may be entertained. If the solids, however, run habitually much in excess of this amount, it denotes that the kidneys are being overworked, generally as the result of overeating or that tissue destruction is taking place, and, when by appropriate manipulation of the fluid and NaCl intake, concentration of the urine does not take place, it strongly indicates a chronic interstitial nephritis. Albumin and casts are rarely present in chronic cases in abundance unless an acute exacerbation be present. Either may be present without the other, and both may be absent for long periods, but may be commonly found sooner or later if persistently searched for. The significance of their presence or absence must not be overestimated. In cases where the blood-pressure is found to be high (in the neighborhood of 190 mm. or more) and other causative conditions can be eliminated, the diagnosis of Bright's disease can often safely be made, whether or not albumin or casts are demonstrated by the chemic and microscopic examination of the urine. Chemical examination of the urine for retained nitrogenous bodies in abnormal amounts is probably our most certain diagnostic sign, though by no means infallible.

Correct *prognosis in Bright's disease* can be given only after all factors have been considered. Acute Bright's disease, so far as immediate danger to life is concerned, ordinarily presents a fairly good prognosis when it is not grafted on a previously existing chronic condition. It often, however, leaves as a sequel persistent inflammation, which in turn may set up a fibrosis, and the various forms of parenchymatous and other acute or chronic

degenerative changes may ensue with or without persistent inflammatory lesions. The prognosis in these cases is dependent to a great extent on the amount of tissue involved and on whether one or both kidneys are affected, clinically obvious facts most difficult to ascertain, but greatly assisted by our newer methods of study. Although definite and unmistakable evidences of persisting renal disease may be present, and though such an applicant is immediately rejected by life insurance companies, he frequently still exhibits a fair state of general health, and may live in reasonable activity for many years.

In attempting to prognosticate the outcome of such conditions, aid may be obtained from ureteral catheterization, the phenolphthalein, Mosenthal, or Albarran tests, and the like. Generally, in such cases, if the kidneys and other excretory organs are doing their work, if the retained nitrogen be not higher nor the blood-pressure greatly elevated, and if the patient can be kept amid good hygienic surroundings, and the habits of life, particularly regarding diet, can be approximately regulated, the prognosis is fairly good.

When a diagnosis of chronic interstitial nephritis is made, and it is found that the kidneys are unable to eliminate the average amount of solids in twenty-four hours, and that a persistent blood-pressure of 200 or more is present, the prognosis is definitely bad. If general edema has already set in, in almost every case death ensues within a few months at the latest. When the blood-pressure in such cases is within normal limits, but not indicative of a failing circulatory capability, even if general edema has already appeared, the prognosis, although extremely grave, is not so serious. On the contrary, when the pressure, having been persistently high, falls suddenly to the normal or below, it is a most serious prognostic sign and usually precedes death by but a short time. Under proper treatment, and particularly by lessening the work of the kidneys, some chronic nephritis patients may live for years. The correctness of the prognosis is dependent to a great extent upon the accuracy with which the diagnosis was made; as has been demonstrated, this cannot be formed from an examination of the urine alone, but depends more largely on the clinical picture presented by the entire case, and especially on the condition of the cardiovascular apparatus.

THE TREATMENT OF NEPHRITIS

There is no more severe test of the skill of the physician than in the management of cases of Bright's disease. In no class of disorders is it more certain that each case must be treated individually, and, therefore, no routine method of treatment can safely be adopted.

It is particularly important in the care of nephritic patients that all the viscera of the body be well considered in each step of the treatment, for interdependence of the various body functions is a most important factor in this group of diseases. Furthermore, it often becomes absolutely necessary to change the entire line of treatment in a case that may have progressed favorably up to a certain point. Continual vigilance is imperative if the best results are to be attained.

Acute Nephritis.—In the treatment of acute nephritis the general or non-medicinal side plays a very essential part. The patient should in all cases be ordered to bed, preferably clad in light woollen sleeping garments, so devised that they may be changed or removed when necessary without unduly exposing the body. Night-gowns that open at the side or in front, fastening with tapes instead of buttons, have been found very convenient, much more so than pajamas. The sick-room should be kept at a uniform temperature and although an abundance of fresh air must be insured, the patient should be carefully protected from sudden changes and shielded from drafts that may suddenly chill the body. It has been found advantageous in most cases to keep the room temperature somewhat higher than is required in most other diseases—from 68° to 72° F., for example.

Not only is mere physical rest demanded, but absolute mental quiet is also most essential. To insure this, visitors should generally be excluded, at least in the early and critical stages of the disease, and only those should be allowed to see the patient who, it is found, have a good effect on his psychic state. The patient must especially be freed from business, social, and particularly domestic worry. These are matters, it is believed, that are of critical value, and for these reasons treatment in the hospital or sanatorium may be found much more successful than at home.

Symptomatic treatment must be instituted from the outset. When it becomes necessary to relieve pain, the writers prefer to use, for this purpose, mechanic rather than medicinal measures, when the former can be made to suffice; thus cupping or the application of leeches to the loins often gives relief from the severe backache which is sometimes a prominent symptom of the disease. When necessary, however, the writers do not hesitate to give codein or morphin in small doses, or when a mere sedative is demanded, chloral or bromids, in small amounts, given by the rectum, have been found to be not only harmless, but actually beneficial, not only in quieting pain but also in diminishing nervous strain or worry, in producing sleep, and oftentimes in reducing either directly or indirectly the blood-pressure.

The diet is a matter of paramount importance. Since the acute course is often short, and since, as a rule, the kidneys are already overworked, there should be no hesitation in limiting the amount of food to be given in early and active cases to the minimum, even as little as 600 calories per day may amply suffice for periods of several days. In these instances the only food should be milk and cream administered in quantities of from 1 to 1.5 liters. For this purpose the writers prefer, as a rule, to give peptonized milk, though malted milk, buttermilk, koumyss, matzoon, or plain top-milk may be preferred. Although they do not approve of a strict milk diet in nephritis of any grade except temporarily in that just mentioned, still there can be no doubt but that it should form the basis and most essential portion of the nephritic diet. The quantity of water that it contains is in some cases very beneficial; in others, however, this fluid is positively injurious, as it throws too great a strain on the congested and overworked organs and the amount of phosphoric acid and of albumins may be definitely irritating. Where mere calories seem needed, lactose may be added to the milk.

We frequently also employ a lemonade or other fruit juice prepared of 1000 c.c. of water, 200 gm. of milk-sugar, and flavored with fruit juice to taste. It is usually grateful to the patient, absolutely non-irritating, and liberates about 200 calories of food value.

Oatmeal, arrowroot, and barley gruels are acceptable foods, and they may be given with cream, which, in the acute phases of

nephritis, the writers believe to be beneficial, especially in those cases in which the amount of other food allowed is, and should be, small.

The white meats may not be contraindicated except in actively acute cases, and the writers have frequently used them; moreover, in certain cases, especially when food stimulation seems necessary, they do not hesitate to employ red meat in small amounts or expressed meat-juice, slightly cooked, and given with some digestive, when the experiment shows that the retained blood nitrogen is not thereby increased. The writers desire, however, to warn particularly against the use of the meat extractives, such as beef-tea, mutton and chicken broths. The amount of nourishment contained in these substances is relatively small, and the extractives that make up the greater part of their oxidizable elements are often intensely irritating to the kidney.

During convalescence, bread and butter, toast, milk-toast, green vegetables, spinach, celery, and the like may be given. Fresh and stewed fruits and unfermented fruit-juices are very acceptable to most patients; they do no harm and have a certain nutritive value. It may also be necessary, in this stage of the disease, to give more freely of meat and other nitrogenous foods, but the return to a normal diet must be made slowly, each advance being well considered before being undertaken, especially in regard to nitrogen-rich substances.

One of the most disputed points in the treatment of acute nephritis lies in the quantity and quality of water to be drunk. Many clinicians advise the use of large amounts of water, even in cases where the tissues are soaked with edematous fluid and where ascites is present. The water, they contend, dilutes the poisons formed by the disease, promotes the activity of the skin and bowel, and finally stimulates diuresis. There can be no question but that, in occasional instances, the free drinking of water is a most useful measure, especially in the intensely toxic types of the disease. The writers have seen many cases, however, in which it resulted in increase of edema, gastro-intestinal disturbance, cardiovascular failure, and aggravation of the renal disease. They prescribe water in excess only in those cases in which edema is not present and in which the toxic manifestations dominate the

disease-picture. In these cases careful note must always be made of the liquid intake and of the amount excreted with the urine and feces, and if it is found that any considerable portion of the water is being retained, or if the amount of urinary excretion is not immediately increased, it often becomes necessary to go to the opposite extreme, and allow only such small quantities of fluid as may be contained in the food or as may be necessary to obviate actual suffering. When the use of water seems desirable, the writers often prescribe it in the form of the no longer fashionable "hot herb tea," which they believe exerts a demulcent action that is frequently of considerable benefit. Thus they employ an infusion of 2 drams of violet flowers steeped for about five minutes in a pint of boiling water—this may be given two or three times daily; besides stimulating diaphoresis and diuresis, this infusion sometimes appears to act also as a soporific. Flaxseed and elder-flower tea, flavored with licorice root, may likewise be used with benefit. Many special spring waters are particularly recommended by some physicians, and if one were to believe the advertisements, even those in some reputable medical journals, there are few which are not more or less curative in all renal disorders. It is possible that, as von Noorden states, those containing lime-salts may, through their consequent combination with the phosphoric acid of the food, lessen the renal irritation, but in most instances they are either valueless or directly harmful, though the cathartic action of certain waters may be really beneficial. Most patients return from the so-called water "cure" worse rather than better.

Whether water be given in large or small amounts, it is customary for the writers to restrict the amount of NaCl ingested, for they believe that this substance inevitably throws an increased amount of work on the kidney, and, by concentrating the body-serum, favors dropsy. Obviously, all renal irritants, such as the condiments, are contraindicated, although in cases in which anuria is present, minute doses of tincture of cantharides have been advocated. The writers have never obtained good results from the use of such drugs, and they also condemn the indiscriminate use of most diuretics, with the exception of the occasional employment of that just mentioned, namely, water.

One of the first and most essential steps in the treatment of acute nephritis consists in establishing free diaphoresis and catharsis. The former is particularly indicated when edema or dropsy is present. In the writers' opinion, diaphoresis is best stimulated by the use of the hot-pack, thermo-electric bath, or the employment of dry heat. When either of these measures is used, attention must be paid to the action of the heart, and not infrequently, in cases of anuria, diuresis as well as diaphoresis may be satisfactorily established simply by regulating the circulatory apparatus. Aconite may be employed with advantage when overactivity of the heart exists, and sometimes, particularly in the degenerative type of nephritis, digitalis or one of the preparations of strophanthus may be used. We rarely prescribe these drugs, however, except where definite circulatory disturbances are manifest.

The results following the use of pilocarpin to stimulate diaphoresis has not justified its recommendation, except as an extreme measure.

Catharsis is best promoted by the preliminary use of calomel in those cases in which internal medication is not contraindicated. Jalap and elaterium have an excellent effect at times, and the concentrated solutions of magnesium sulphate, either given by the mouth or used as an enema, generally prove most satisfactory.

In the presence of coma, elaterium, jaborandi, and pilocarpin may be necessary, but even here the greatest reliance is to be placed on the hot pack or on the hot-air treatment, on stimulation of the heart when necessary, and on the maintenance of free catharsis. Bleeding often is of the greatest possible benefit in such cases, and where edema is not present and toxemia is marked, saline infusions may appropriately follow.

In those cases in which effusions of serum into the pleural and peritoneal cavities exist, the writers believe the proper treatment to consist of early and, if necessary, frequent aspiration; the same measure—that is, puncture and occasionally the use of cannulas—may also be employed in those cases in which excessive edema of the extremities is present. Particular care must be exercised to guard against infection. Pulmonary edema may be treated by cupping or by the use of atropin and cardiac stimulants.

Throughout the entire course of the disease symptomatic treat-

ment is constantly necessary, but, whenever possible, drugs should be avoided, since they have a tendency, in most cases, to increase the work of the kidneys without corresponding relief. Care directed to the action and conservation of the heart and vascular apparatus is secondary in importance only to that of the kidney itself; acute dilatation of the heart must be looked for and guarded against; excessive blood-pressure must be detected and relieved—which is best accomplished by phlebotomy or by the temporary use of the nitrites, nitroglycerin, or sometimes by chloral; and, on the other hand, sudden or marked decrease in the blood-pressure must be looked for, and, if possible, prevented.

The management of the convalescence of acute nephritis applies practically to the early treatment of chronic nephritis, since all, or nearly all, attacks of acute nephritis leave in the kidney certain inflammatory or degenerative lesions that persist for months after the acute symptoms of the disease have disappeared, but which must, nevertheless, be constantly borne in mind by the discreet clinician.

The Treatment of Chronic Bright's Disease.—The medicinal treatment of chronic nephritis has been sufficiently considered under the head of the active treatment of acute types of the disease, for in the chronic form, as a rule, little or no medication is required except when symptoms of a subacute nature arise or acute exacerbations appear. Such instances are to be managed precisely as in the acute disease in so far as the use of drugs and general therapeutic measures are concerned. As a matter of fact, active manifestations in the chronic course differ but little from the acute disease except that, as a rule, the prognosis is not so good and response to treatment is rather less rapid. The sooner therapeutic measures are resorted to, the more favorable the prognosis and the earlier restoration to health, or rather to comparative health, for it must be remembered that in chronic nephritis the lesions inflicted on the kidney are essentially of a permanent character, though clinical recovery is, of course, by no means rare.

The most important phase of the management of cases of chronic Bright's disease, either of the degenerative or interstitial type, is the prophylactic measures employed, as a result of which acute or subacute symptoms are obviated and the progress of the dis-

ease becomes checked. A most careful study of the patient, and particularly of his relationship to his surroundings, is therefore absolutely essential. Only the most general rules can be laid down in this regard, for not only does each case differ in itself, but also in the necessary conditions of life which surround it. These latter often determine, even more than the actual anatomic lesion, the course of the case, and successful treatment, therefore, presupposes a thorough study of the individual and his obligations.

Personal Hygiene.—One of the most serious matters of personal hygiene is the selection of occupation. In most cases we find in this regard that necessity lays down rules over which the physician may not trespass, but in nearly all cases, even the most unfavorable, ameliorating conditions may be so introduced as to work great relief to the patient without the ruin of his business prospects. The hours for work should, if possible, be limited; this is, in our opinion, more necessary for professional men than for the laboring and business classes, on account of the demand for emergency work and great nervous strain coupled with most professional vocations. Good ventilation of the office or workroom is important, and the air must be freed in so far as possible from dust and any irritating gases, for the importance of healthy pulmonary excretion is universally recognized for all cases of crippled kidneys. Sunlight is also desirable, and obviously work by day is more advisable than night occupation. Work in damp, dark basements or in improperly warmed quarters is very deleterious, and these are conditions which we find very often associated with the most serious types of the disease as we see it, particularly in the great cities.

Occupations which are in themselves dangerous for the renal function must be given up; such as, for example, in chemical works or factories where absorption of irritating substances may occur, the excretion of which excites renal disease. Excitement and nervous strain are to be eliminated in so far as possible; worry is in itself one of the most common productive factors of chronic nephritis, and the patient must be, therefore, relieved in this respect.

The clothing should not be too heavy, but it should be suffi-

cient for requisite protection of the body. Extremes of heat or cold imposed by climatic necessities should in all cases be properly considered in the choice of clothing. As a rule, we have found that light wools are best for the undergarments, even for summer wear, and in all climates, even in the tropics, for night use. Silk may be also so worn.

The outer clothing should be selected with direct reference to the climatic conditions. In the temperate climates light wools of medium grade should be selected according to the season, and in the tropics linen or cotton is commonly desirable. Overcoats should always be at hand where sudden changes in the temperature or humidity are to be expected, and the patient must avoid chilling of the body surface.

The question of baths is a most important one, and is to a large degree determined by the condition of the circulatory system of the patient. When no contraindications exist, frequent warm or even hot baths are desirable, so that the skin may be kept free and clean with its excretory possibilities at the maximum. Hot baths should not be taken except immediately before going to bed or if they be terminated by gradual transition to cold water of a temperature not over that of the outside air. Except in the case of stout persons where the cardiac condition is excellent, we do not advise the Turkish bath, and we consider it a dangerous procedure in a very large number of cases, especially where the heart is in doubtful condition. The same effects may be safely achieved by the hot pack, which may be given at regular intervals in appropriate cases. We do not recommend the cold plunge, although there may be instances where good reaction follows and in which the observation of the individual case demonstrates that it is beneficial. The spray, shower, or needle bath as a general thing possesses all the stimulating effects of the plunge without the sudden and often dangerous shock.

Massage is a very beneficial measure, especially for patients of sedentary habit. Properly administered, it stimulates the peripheral circulation, improves the excretory powers of the skin, and keeps the skeletal muscles in good tone. It is not and cannot become a satisfactory substitute for actual physical exercise, though it may be a very convenient makeshift, especially for bed-

ridden cases and when, from the nature or demands of life or occupation, physical exercise is impracticable.

Exercise of one kind or another should be insisted upon in all except bed cases—the amount and nature of the work must, however, vary according to the needs of the case. In the determination of what form is most beneficial one must particularly consider the usual habits of the patient, the state of his circulatory system, and, often most important of all, what the patient is willing to do. We have found, especially in this matter of exercise, that the inclination of the patient must be largely considered, if the necessary persistent continuation of the exercise is to be obtained.

Walking, when it does not consume too much time, is often very desirable. One can very readily grade the amount of this exercise, increasing or diminishing the length and the slope to be mounted, after the plan devised by Oertel. Golf is a most agreeable vehicle of exercise for many patients, and here also exact gradation of the amount is readily arranged. All violent forms are generally to be avoided, but each case must be considered alone in this regard and the amount and form of exercise can be best determined by observation of the effect on the patient, and in this matter the opinion of the patient as to the conditions under which he feels best are oftentimes of paramount importance.

Although it is impossible to lay down any hard and fast rules in regard to the climatic conditions most favorable for chronic nephritic patients, certain general requirements may be quite definitely stated. Climates in which neither extreme of heat or cold occurs, or in which the temperature changes take place gradually, are always to be preferred. Nephritic patients, as a rule, do not do well in the tropics; neither does the cold climate of such localities as the Canadian Northwest nor the more northern portions of the United States seem well adapted to most cases, though some live in these places with comfort and without harm.

When the social and financial condition of the patient permits, it is well to spend the winters in the mild climates, as in Florida, Southern California, Egypt, or Bermuda, and the summers in the north.

On the whole, the drier climates seem best adapted to the needs of chronic cases, and a climate such as that of Arizona, Idaho, or

Montana seems favorable in most instances, though, as before mentioned, some cases do very well in Bermuda or Florida. The South Sea Islands have also been highly recommended.

Altitude in itself seems of little importance except in those cases where cardiac and vascular lesions are matters of active concern. In these instances the general rules for cases of myocarditis or arteriosclerosis should apply.

Food.—The question of proper food for cases of chronic Bright's is a matter at once of the greatest importance and of the greatest difficulty. The time has long passed when all cases of Bright's disease are advised a strictly milk diet, though we cannot deny but that some cases do best under this régime. In the treatment of chronic nephritis more than in anything else we should study the individual and his reaction under various food combinations. In this regard, though we realize that the amount of albumin in the urine is no measure of the gravity of a case, it is well to watch closely the albuminuria, and when it increases with certain articles of diet, or when blood or casts appear or increase, these articles should be promptly eliminated.

It is a safe general rule to follow that the amount of nitrogenous food taken in should be governed by the facility with which combustion takes place in the body. In this respect we shall find great variation, and though in general the nitrogenous foods should be kept low, yet the amount must be sufficient for the best physical welfare of the patient. Red meat is not interdicted, but the white meats, including fish and eggs, appear to furnish a sufficient energy with perhaps less renal and vascular strain. This is, of course, manifestly controlled in part by the nature, occupation, and habits of life of the patient. The diet necessary for a laboring man should, of course, be more rich in nitrogen than that of an office worker, though it will be found that certain men of sedentary habits also do best on a diet relatively rich in nitrogen. It is foolish to restrict a patient for the most part to carbohydrates when it is shown objectively that these foods do not furnish the requisite amount of energy for that person, or when they set up gastric or intestinal fermentation, which in itself does far more harm to the kidneys than a reasonable normal diet could. Briefly, then, we must base our diet, not on theory or

generalities, but entirely on the effect in the individual case. Generally from 3000 to 4000 calories per day should suffice, and in our experiences outside of the hospital the tendency has been rather to over- than to underfeed.

Condiments, such as pepper and the highly spiced sauces, must, of course, be excluded. Alcohol is never to be taken except in small amounts or when the drug is needed for its therapeutic effect. Some cases, however, when habituated to alcohol lose ground when entirely deprived of it, and, properly administered, it may be but slightly or not at all irritating to the kidneys. Coffee and tea may be temperately used in most cases to good advantage. Where coffee overstimulates, the brands largely freed from caffein may be given.

The amount of water demanded depends largely on the rate of excretion in the urine, on diaphoresis, and on the effects on the vascular organs. As a rule, it should be less rather than too large, particularly in interstitial cases. Salt is always to be curtailed, especially for those who normally desire large amounts of this chemical or where edema is present. In cases associated with gout and rheumatism it will, however, be found necessary to be more liberal in the use of water, and in practically all cases the occasional copious use of water, as suggested by von Noorden, is beneficial.

Decortication of the kidney is discussed under the Surgery of the Kidney. We do not advise it in any case.

Cases of chronic Bright's disease should always be kept under frequent observation. Very careful supervision of diet is necessary as long as life exists. Timely symptomatic use of drugs, of the diuretics, diaphoretics, saline cathartics, and a carefully regulated life usually so benefit that the disease may no longer be thought inconsistent with a long and relatively active life.

CHAPTER X

UREMIA

Inasmuch as uremia occasionally occurs independent of clinically recognizable Bright's disease, it has seemed well to the writers to discuss it as though it were a disease entity.

Because of the obscurity of the pathologic conditions underlying uremia it is deemed advisable first to consider the disease from its clinical aspects.

For our purposes Osler's classification of the disease by its symptoms will be adopted with a few modifications, and it will be discussed under the headings of cerebral, dyspneic, gastro-intestinal, and renal types.

The most striking symptoms of uremia are those of cerebral origin. Of these, a more or less active mania is most commonly seen; this may manifest itself in talkativeness, which is generally illogical and rambling, in marked physical and mental restlessness, with insomnia, and sometimes by active emotional delirium, persistent hallucinations, or perhaps melancholic delusions. All these abnormal manifestations closely resemble those seen in many cases of acute alcoholism, and very often closely approximate the Korsakoff syndrome.

Convulsive seizures are common, and not infrequently resemble those characterizing mild attacks of Jacksonian epilepsy; there may be sudden loss and as sudden recovery of vision, or convulsive attacks of projectile vomiting may occur. The breath often becomes almost ammoniacal in odor, and the assertions of older clinicians that the condition may be detected from the odor given out by the patient is sometimes confirmed.

Coma is one of the most familiar of the cerebral evidences of uremia. It may amount simply to sleepiness or torpor of longer or shorter duration. Great difficulty will be experienced in distinguishing this particular type of the disease from alcoholism, but in this regard it must always be borne in mind that true

uremia frequently appears as a terminal complication of alcoholism.

The knee-jerks, at first usually excited, commonly are lost toward the end, and almost always the Babinski reflex or the Oppenheim, or both, become positive a considerable time before death impends. Tremors of a fine type are frequently seen.

Local palsies are very common in uremia, and many cases are seen presenting first symptoms quite typical of hemiglegia or of paralysis of individual muscles or groups of muscles. Ordinarily, such cases are easily distinguished from those of actual paralysis by the incoherence of the symptoms and by their evanescent character, as well as by the presence of manifestations of renal insufficiency—points of paramount value in the differential diagnosis of all types of uremia. Cases diagnosed as cerebral hemorrhage or embolism are often found on postmortem examination to have been purely uremic.

The patients presenting respiratory symptoms show in the milder cases paroxysmal or alternating dyspnea, and in the more severe cases the breathing takes on the character of the Cheyne-Stokes respiration. These symptoms are apparently due to a disturbed CO_2 coefficient.

The most common gastro-intestinal symptom is nausea, which is often very persistent, and is sometimes accompanied by propulsive vomiting, as in cerebral tumor. Diarrhea is also a frequent symptom, but probably occurs only as an effort at compensatory excretion on the part of the bowel. For the same reason, profuse sweating is often a marked symptom, and occasionally the perspiration is loaded with urea and other excrementitious products.

The kidney manifestations usually present in uremia may be summarized as those of decreased renal activity, generally shown by a relative decrease in the amount of solids, and particularly in the amount of urea, excreted. Often the symptoms of active renal disease accompany these indications of renal inactivity, and albumin, casts, blood, and desquamated epithelium appear in the urine. Acute suppression is quite frequent.

Although it is generally admitted that uremia is a condition dependent on disease or inactivity of the kidney, the pathologic

conditions that produce this inactivity are obscure. Uremia occurs not so very rarely when the quantity of urine excreted is normal, and when the urea and other solids are still apparently in normal relation. We are therefore forced to the conclusion that in these instances the condition may exist without evident renal disease. In this regard it should be borne in mind that the state of the urine is by no means always a positive determinative test of the actual condition of the kidneys. Nevertheless, it is generally conceded that uremia is due in all cases to the presence of renal lesions, and it remains for us to determine the manner in which renal insufficiency may declare itself. Uremia is generally regarded as the result of some form of poisoning, dependent on deficient excretion, by the kidneys, of toxins formed in the course of tissue metabolism.

The earliest belief was that the condition was caused by the presence, in the blood, of an abnormally large amount of urea, which should have been excreted from the body by the action of the kidneys. As a matter of fact, the blood in uremia usually does contain an abnormally high percentage of urea; exceptional cases are met, however, in which the amount of urea present in the blood has not increased when uremic symptoms manifested themselves. Cases also occur in which there is an excessive amount of urea in the blood without the development of uremia, so that although urea is usually present in large amounts in the blood and tissues of uremic subjects, this is not invariably the rule, and the disease may arise without any abnormal increase. Again, recent study has tended to confirm the old idea that uremia is or may be truly a poisoning from the retention of urea in the blood.

The preponderant experimental evidence has, however, apparently proved that the introduction of urea into the circulation is not productive of uremic symptoms; if, however, this is complicated by injuries to the renal tissues, some experimenters have asserted that symptoms resembling those of uremia are produced. This statement has not received sufficient corroboration to justify absolute acceptance. Urea is used in the treatment of disease, especially as a diuretic, and it is quite certain, from abundant experience, that the condition is not due simply to the presence of urea in the blood.

The next and most natural supposition is that the poison of uremia (for the condition is clinically a toxemia) is due to the formation, in the blood, of bodies allied to, or derived from, urea. Frerichs promulgated the theory that it was due to the presence of ammonium carbonate, which was formed in the blood as the result of fermentation, which had resulted in disintegration of the urea molecule. This seemed for a time to adequately explain the symptomatology, but later investigations showed that ammonium carbonate, when introduced into the blood, does not produce the symptoms of uremia, even when, in addition, the kidney tissue is subjected to traumatism and normal excretion is prevented.

The next supposition advanced was that the symptoms were caused chiefly by other, perhaps unrecognizable, excrementitious products in the blood. Investigations have also failed to demonstrate this satisfactorily, for, as has previously been stated, the symptoms occasionally arise in those cases in which the urine and blood themselves are normal. It must be remembered, in this connection, that information regarding the exact nature of all these bodies is still wanting, and our knowledge of the chemistry of the blood and urine is not sufficiently complete to warrant us in discrediting the foregoing statement. The fact that we have as yet been unable to demonstrate its truth by no means disproves its possibility.

The recent studies of the blood which show in most, but not all, cases of clinical uremia that the amount of filterable nitrogenous bodies retained in the blood, often four to ten times the normal, may possibly represent such poisons. In some of our personal observations, however, typical clinical cases of uremia have shown no increase in these elements in the blood, and while there can be no question whatever that we are now much nearer to the solution of this problem, it is as yet by no means solved.

Osler holds that interference with the renal functions leads to a disturbance of the regular chemic changes in all parts of the body; such a change is followed by alteration in the nutrition of the tissue, showing itself in a loss of weight, in anemia, and in cerebral disturbances. This theory is so indefinite and broad as to be of no aid to us in explaining the cause or the course of the disease, nor is it substantiated by clinical or by experimental evidence.

Traube has presented a theory that the symptoms are really due to morphologic lesions and not to chemic toxemia. He asserts that interference with the renal functions, which all admit is at the origin or root of the disease, leads to a thinning of the blood-serum, to hypertrophy of the left ventricle of the heart, and to excess of arterial pressure. Now, if by any accident or circumstance the pressure is increased still more and the serum still further thinned, anemia and edema of the brain follow, causing various uremic manifestations, according as certain portions of the central nervous organs become affected. This theory is founded on the assertion that the blood pressure is always increased in uremia,—a statement that is not invariably true,—and that the specific gravity of the blood-serum is always diminished—a statement that is likewise not invariably, although it is generally, true. Further, it is stated that anemia and edema of the brain are not always present. Personally, the writers are inclined to accept, to a certain extent, this theory, in so far as the symptomatology is concerned, for in their own cases they have found that a localized edema and anemia of the brain is generally present; and they know that in other similar conditions, symptoms resembling those of uremia are induced by cerebral edema, but we also believe that these changes are induced by chemical toxins in some way dependent primarily on renal lesions.

Stengel advances the theory that the degenerated cells of the kidney may in themselves liberate a poison that acts on the brain-cells in the manner indicated by the symptoms of the disease; this is the theory of the formation of the nephrotoxins. There is no absolute data on which this theory is based—it is purely speculative.

In certain types of uremia we are unable to demonstrate at postmortem any lesions in the kidney to account for the symptoms; for example, in the marked toxic uremia that takes place during pregnancy and puerperal eclampsia no changes may be found (Delafield). Of course, it is possible that our methods are not sufficiently accurate to enable us to detect all important changes that may, nevertheless, be present, but, notwithstanding this, it must be admitted that certain classes of cases arise in which the explanation founded on the basis of pure kidney lesions is

inadequate. In this relation it is well to consider the possibility of the toxin being other than of renal origin. Its absence in purely traumatic or quantitative kidney lesions is of much significance, and it seems opportune here to review briefly some of the experimental work on uremia in which ablation of kidney tissue has been performed.

It has been found that when both kidneys are removed or totally destroyed by disease life lasts seven to fourteen days. The chief symptoms observed in these cases, aside, of course, from complete anuria, are contraction of the pupils, muscular weakness, and subnormal temperature; severe vomiting is occasionally observed. There is no loss of consciousness, and the convulsions so characteristic of uremia are not present. Hence we find that uremia is not typified by the same symptoms that follow complete absence of renal tissue.

Again the question arises as to the possibility of uremia developing when a portion of the kidney substance is removed—an experimental condition that much more closely approximates those found in most diseased states. According to Bradford, the only effect noted if part of one kidney is removed is an increase in the amount of water secreted; no general symptoms appear. If, in addition to the first operation, the other kidney is afterward entirely removed, there is a persistent and great increase in the amount of water secreted, but no other symptoms arise if one-third of the normal kidney weight remains. Removal of three-fourths of the kidney weight proves fatal, and the subject dies, greatly emaciated, diarrhea and subnormal temperature being occasionally observed as symptoms; there is a great accumulation of urea in the blood and in the body tissues, and this probably accounts for the polyuria. Coma, convulsions, and all other symptoms typical of uremia are entirely wanting. Thus it may be seen that uremia is apparently not due to a decrease in the volume of functionating kidney tissue; neither does it seem to be due to the presence of urea and allied bodies in the blood and tissue of the body, even when this surplus urea is formed by the body-cells in the normal manner and is not introduced artificially.

Lesions of the Kidneys Present in Uremia.—Uremia frequently occurs as the immediate cause of death in scarlatinal nephritis,

in pneumonia, and in similar acute infectious diseases; it is also seen as a sequel to alcoholism. In both infectious diseases and in acute alcoholism it is associated with the lesions of acute diffuse nephritis, which, arising from any cause whatever, are very commonly followed by uremia. Uremia may further be looked upon as the ordinary terminal condition in chronic interstitial nephritis, especially in that variety in which the small sclerotic kidney is found; thus it may be seen in cases of chronic alcoholism, in lead poisoning, and in gout. It also occurs, although somewhat less frequently, in those cases in which a chronic interstitial hyperplasia has taken place, as in chronic diffuse nephritis of the interstitial type. It arises in all the degenerative, particularly in all the chronic degenerative, processes, as in long-standing amyloid degeneration, and especially in those long-standing cases in which an acute complication or exacerbation intervenes.

On the other hand, as would commonly be inferred from the experiments cited, uremia should not occur in such lesions as pyonephrosis, renal calculus, hydronephrosis, nor in those changes that are characterized by more or less simple destruction of renal tissue.

The experiments of Bouchard and of others have shown that normal urine, when experimentally introduced into animals, possesses a more or less constant and definite degree of toxicity. Other investigations, founded on those just mentioned, have also shown that this degree of toxicity varies in different diseases in a degree almost constant, being increased in certain conditions, as in various infectious processes, and decreased in others, notably in uremia. These observations apparently indicate that in uremia certain toxins are either not formed at all or, if formed, are not eliminated, but retained in the tissues of the body. This may be construed to mean that in uremia these toxic bodies may be responsible for the typical toxic symptoms. As is at once apparent, our more recent knowledge of the usual blood chemistry in uremia tends to substantiate this concept. Ablation experiments seem to show that these specific toxins are not formed nor retained when morphologic destruction of the renal substance is effected, and the renal lesions apparently show that they are present when the pathologic lesions of the renal substance are of a

degenerative or hyperplastic character—as, for example, in renal tumors.

Assuming, though admittedly on insufficient evidence, that uremia is solely due to some diseased condition or defective action on the part of the kidneys, the lesions present in the other organs must also be considered.

The principal symptoms of uremia are those affecting the nervous system, chiefly those consequent upon disorders of the cerebrum. The most marked and constant lesions seen in the brain consist in the formation of a considerable serous exudate, particularly in the subarachnoid space, and especially over the vertex, although the exudation may be general over the entire surface of the brain. Occasionally the exudate is localized to some particular area of the membranes, thus accounting, perhaps, for the localizing symptoms, almost Jacksonian in type, presented by certain cases. This exudate is often sufficient to cause an appreciable compression of the cortex. The vessels of the pia are at times congested in one area and perhaps very anemic and contracted in another.

The lesions of the brain tissue resemble those of the membranes very closely in their general nature. Thus edema is usually present in greater or less degree; often it is very extreme, and large quantities of serum, usually very clear and limpid, drip from the cut surface. The edema may be localized and this is more common in the cortical than in the lower areas, thus bearing out the clinical manifestations that the more pronounced cerebral symptoms are those of cortical derangement. The blood-vessels are often markedly congested, but they may vary greatly in this particular, even in the same brain. Microscopically maceration of the tissue immediately beneath the edematous membrane is generally observed, and this is also sometimes well shown about the perivascular lymph-spaces of the cerebral tissue. Arteriosclerosis is frequently seen, perhaps, because when present also in the kidney it predisposes to the development of uremia.

If the case has been of long standing, or if the subject has had previous attacks, thickening and hyperplasia of the connective tissue of the pia, marking the site of old exudations, are found. This is the cause, at least in some cases, of the areas of opalescence

which are found so often along the track of the chief meningeal vessels in old nephritic cases. In the brain tissue proper this process is represented by areas of gliomatosis, generally of very slight extent. From a consideration of these lesions it can readily be understood why uremia is so commonly mistaken for cerebral hemorrhage, brain softening, embolism, and other similar grave and permanent lesions. Changes have also been found in the ganglion-cells; these may amount, in severe or prolonged cases, to actual cell-destruction, but, as a rule, they do not extend beyond degeneration, more or less pronounced, of the chromophyllic plaques of the ganglion-cells.

The alterations that occur in the other viscera are neither constant nor characteristic. As a rule, hypertrophy of the heart, particularly of the left ventricle, is present; the blood-vessels are thickened, at times dilated and at others much contracted.

The edema, which is quite generally present in the disease, is usually due to the primary renal disease, although acute idiopathic edema often develops in uremia and acts as the immediate cause of death. It is highly probable, however, that in this condition lesions of the central nervous system are largely responsible.

As a general rule, the cause of death in uremia is due to cardiac failure or acute pulmonary edema. In the former the lesion of the heart muscle may be looked upon as due, at least in part, to the action of the toxins; or, on the other hand, a myocarditis may arise following primary renal disease.

In summarizing, uremia may be defined as—a series of manifestations, chiefly nervous, developing in the course of Bright's disease, and probably due to the retention or presence, in the blood, of certain poisonous materials that most likely result from the abnormal action of degenerated renal cells. This is in substance the definition proposed by Osler.

Diagnosis.—In well-developed, typical cases of uremia, when a complete history of the case in question is available, the diagnosis is easy. In its milder manifestations, when the symptoms are but slightly developed, the diagnosis is difficult and often impossible. A history of headache, edema, and particularly of a diminution, especially very recent, in the amount of urine excreted,

is of the greatest importance. When the urine is continuously of low total specific gravity, and when this cannot be increased, either by quantities of water or by reduction in the fluid intake, another highly diagnostic fact is added to the clinical picture. As a rule the sodium chlorid output is very small, irrespective to the intake of this salt. When the disease is fully developed, such symptoms as vomiting, stertorous breathing, coma or somnolence, less frequently maniacal symptoms, associated with increased blood-pressure, hypertrophy of the heart, particularly of the left ventricle, and, perhaps most important of all, diminution in the amount of urine excreted, together with the appearance in it of albumin, casts, renal epithelium, and probably blood, leave little doubt as to the diagnosis. Nevertheless, circumstances may arise, even in the most typical case, that will greatly complicate and confuse the diagnosis.

Perhaps one of the most characteristic manifestations of uremia, and one which permits its differentiation, in the majority of cases, from diseases manifesting similar symptoms, is the variability of its clinical aspects. The pulse, which in the ordinary case is hard, full, and bounding, may within a few hours become soft and feeble, to be followed again, perhaps, by a return of the high pressure. The occurrence and disappearance of edema, when present, is an important differential sign.

There is no one feature of the disease that is of greater value, and at the same time occasionally more misleading, than the condition of the urine. In typical cases the amount of urine, and the percentage of urea in particular, is considerably diminished; on the other hand, some cases, especially those occurring in chronic nephritis, are particularly likely to be associated with polyuria. Still more rarely the urine may be normal in amount, in chemic content, and casts and epithelium may be entirely absent. Repeated examinations will usually, however, eventually corroborate the existence of nephritis. The differentiation is particularly difficult when albuminuria or a true nephritis occurs at the onset of an acute infectious disease, the picture of which may closely simulate uremia. As a rule, the blood shows a greater or less increase in hemoglobin, and chemical study shows a marked nitrogen retention. Nitrogen partition studies show generally that creatinin is especially increased. Blood urea is mostly found

increased greatly, and so also may the chlorids of the blood, but, as a rule, the chlorids seem to be more retained in the tissues rather than in the body fluids. In many instances, of course, the blood-pressure is increased, but in late stages it may be normal or even subnormal. As a rule, even where in terminal stages the systolic pressure is low, diastolic pressure is likely to remain high, with a resulting very low pulse pressure, which we believe to be a very grave prognostic sign. As a rule, the temperature-curve in any of the acute infections is more or less characteristic, and the presence of a leukocytosis aids materially in the differential diagnosis. In typhoid, hypoleukocytosis, mononuclear increase, and the presence of the Widal reaction make differentiation certain. Miliary tuberculosis, particularly where early involvement of the cerebral meninges takes place, is often distinguished with much difficulty, and frequently a differentiation is impossible until definite tubercular lesions can be demonstrated, as in the retina, or until pleurisy or peritonitis develops. The differentiation from septicemia associated with albuminuria may be possible only when metastatic suppuration can be demonstrated.

Uremia is differentiated with particular difficulty from true focal lesions of the brain, as in embolism, hemorrhage, or meningitis. The character of the pulse is identical in many conditions, and when, as is so often the case, nephritis preëxisted, differentiation may be impossible. This is particularly true in cerebral hemorrhage. In nearly all these conditions a positive diagnosis can be reached only when, as almost always happens in uremia, the picture of the paralysis suddenly changes. There is almost invariably a certain incoherence of symptoms when the case is under careful observation, but when seen for the first time, an absolute diagnosis is impossible. In this relation it is well to remember that cerebral embolism and cerebral hemorrhage sometimes occur in uremia, a fact amply demonstrated in a series of postmortems performed by the writers. The ophthalmic examination is often of great differential value, since the presence of albuminuric retinitis, in the absence of definite urinary manifestations, may decide the point in question.

The condition is very commonly confused, particularly in hospital and city practice, with various forms of poisoning. This is perhaps most true of alcoholism. Here the history of the case is

of the greatest importance. The examination of the urine and the presence or absence of alcoholic tremor may also often make differentiation possible. As a rule, besides, the delirium of alcoholism is of a more active type than is that of uremia. In this regard, however, it must be remembered that uremia occurs as a common terminal condition in alcoholism, as has been demonstrated to the writers by a close study of the material derived from the alcoholic wards of Bellevue Hospital. Opium-poisoning is distinguished with even greater difficulty than alcoholism, when the urine does not present characteristic findings. Ptomain-poisoning and other similar conditions are often confused with uremia, and their distinction may demand a most careful study of the entire course of the disease before a positive diagnosis can be arrived at.

Prognosis.—The prognosis in uremia is dependent on the degree of disease that exists, on the length of time it has been present, on the promptness with which treatment is begun, and on the reaction of the patient to this treatment. It also depends largely on the condition of the general organs of the body, and on the readiness with which the underlying condition responds to treatment. In general, the writers believe that the prognosis is more favorable than is commonly supposed. The mild manifestations, such as headache, decrease in the amount of urine voided, symptoms of early cortical irritation, edema, and the like can usually be relieved; and when subsequent treatment, associated with a careful control of the diet, exercise, and general habits of life, is possible, the prognosis is good. In those cases in which the response to medication is not prompt, the prognosis is generally bad. In any case recurrence, particularly when extra strain is imposed upon the kidneys, may take place; and, although a uremic patient may be restored to comparative health, subsequent attacks are likely to develop at almost any time, the second or third generally terminating fatally.

Treatment.—The cardinal feature in the treatment of uremia should be the stimulation of secondary excretion. The bowels should be freely opened, and oftentimes the most drastic agents are necessary for this purpose. Elaterium, in doses of one-sixth of a grain, is highly recommended; croton oil, in doses of from

one to three minims, repeated until the stools become watery, is also useful. The action of the skin is to be stimulated by the use of hot packs and the administration of pilocarpin, preferably intramuscularly or hypodermatically, in doses of about one-eighth of a grain; when edema lessens the absorptive powers of the skin, it should be given by the mouth. When the condition of the heart is unfavorable, pilocarpin is to be used with care. When the pulse is hard and bounding, one of the most efficient measures, in the writers' experience, is the removal of a quantity of blood and the substitution of saline solution. When necessary, strychnin and digitalin should be employed to support the heart action, and vasodilators should be used freely when the blood-pressure is high. Of the latter, nitroglycerin, in frequent and large doses, is to be recommended for its immediate action, but more permanent benefit has been secured from the use of chloral, as recommended by Peabody, Thompson, and others, the drug being given preferably by the rectum in doses of from 30 to 45 grains. Chloral, in our experience, is one of our most reliable vasodilators.

Although we altogether disagree with Fisher in his acidosis theory of nephritis and of uremia, there is no question whatever but that alkalis often greatly benefit these cases, either given per os, by rectum, or intravenously. We have seen cases almost miraculously respond to this treatment. In other instances, of course, it is absolutely without effect or, perhaps, even detrimental. In our opinion it should never be pushed beyond the point of rendering the urine alkaline or amphoteric.

If convulsions are present, they are to be relieved by chloral and bromids, given preferably by the rectum and in large doses. Urethane has been highly recommended by Peabody for this purpose, but the writers are not sufficiently familiar with it to attest its value. It may be necessary in some cases to employ chloroform for the relief of convulsions, but, except where immediate relief was demanded, chloral has proved much more satisfactory in the writers' hands. When the condition of the patient permits, water may be given in large quantities, or saline enemata or transfusions may be used when the patient is unconscious. Whenever possible, chemical examination of the blood should be made in conjunction with accurate urinary studies, as we may thus

receive a very definite idea of the special poison retained in the blood. The diet advisable must, in large extent, depend very largely on these findings. For example, salt must be rigidly excluded in instances of salt retention, as in edematous cases.

As a general thing the feeding of these cases is of very little consequence; that is, very little food of any kind is advisable, and it is frequently necessary to also restrict the fluid intake to a minimum, but this also must depend to a great extent on whether or not fluid is abnormally retained in the cavities or tissues. As a rule, a considerable and sufficient number of calories may be introduced by giving the lemonade mixture mentioned under the treatment of chronic nephritis.

The after-treatment is that of chronic Bright's disease, attention being paid particularly to the diet and to the habits of life, as detailed under the proper heading. It should constantly be borne in mind that in the treatment of uremia promptness is of the greatest importance, and when one measure fails to act, others should be employed in its stead.

CHAPTER XI

TUBERCULOSIS OF THE KIDNEY.—THE KIDNEY IN SYPHILIS

TUBERCULOSIS OF THE KIDNEY

THERE is probably no other diseased condition of the urinary tract concerning which our knowledge is in a more confused state, particularly as regards prognosis, than it is in respect to tuberculosis of the kidney.

Pathology.—Renal tuberculosis occurs as a not infrequent condition or complication in cases of miliary or generalized tuberculosis. Horst Oertel, pathologist to the City Hospital, reports that, of the seven cases showing renal tuberculosis which came to autopsy at the City Hospital in the year 1904, five complicated the pulmonary disease. In four of the seven cases both organs were involved. Our personal statistics vary somewhat from these in significance, since most of our cases except those of a clearly terminal character have originated independent of detectable pulmonary lesions, but were associated with tubercular lymphadenitis or with a primary tuberculosis of the lower urinary tract. Differing from the ordinary general condition, tuberculosis of the kidney as seen in the primary disease of the genito-urinary tract is often found to be monolateral, and clinical observation has convinced us that it may, when properly supervised, remain so for long periods, provided that secondary infection of the bladder or urethra does not take place. A sharp distinction must therefore be made between those cases in which renal tuberculosis arises as a terminal complication in a practically hopeless case of tuberculosis, and where it originates in, and remains chiefly limited to, the urinary organs. Joseph Walsh[1] found renal tuberculosis present in 43 per cent. of 101 consecutive cases of fatal pulmonary tuberculosis. In practically all these cases, however, in

[1] Third Annual Report, Phipps Institute.

so far as we can gather from the report, the kidney lesions were purely terminal in nature. We believe it a matter of great importance that surgeons and pathologists in reporting cases of renal tuberculosis realize this point, and that in their reports they lay particular stress on the extent or limitation of the disease. It is quite possible that accurate data so compiled may lead to profitable modifications in prognosis and treatment.

Infection takes place in two distinct ways, comparable to those routes already discussed in regard to septic nephritis, which, in many anatomic characteristics, closely resembles tubercular disease:

Infection by ascending inoculation from tubercular lesions of the lower urinary tract, as from the urethra, prostate, bladder, or seminal vesicles, in any of which foci the disease may have originated, or from tuberculosis of the epididymis or testicle. The anatomic pictures differ markedly in the two classes of cases. In ascending infection, tubercular lesions can be usually found in the lower tract and a distinct pyelitis or tubercular pyonephrosis is demonstrable anatomically, and usually clinically as well.

Embolic or Descending Infection.—In embolic infection, unless, as we have indicated, it take place in a wide-spread general infection, the foci are more apt to be solitary, discrete, localized, and may give rise clinically only to the symptoms of renal granuloma, varying in degree with the extent and size of the diseased areas. In this type of infection the tubercles, if multiple, are mostly found in the cortex of the organ, in the distribution of the terminal interlobular arterioles, or in the columns of Bertini, while primary pelvic invasion is the characteristic of the ascending variety. In the former class the course of the disease and the lesions as well are very like those seen in embolic septic processes, and, as a rule, they pursue a relatively innocent course and, as will be pointed out later, are not commonly diagnosed unless the necrosis of the tissue becomes sufficiently extensive to cause drainage into the pelvis or marked febrile symptoms. We except, of course, in this discussion those cases of terminal infection which should not be considered as under the head of renal tuberculosis.

Course.—As might be concluded from the pathologic anatomy, many cases, particularly those of embolic type, pass along with

few disturbances which attract the attention either of the patient or physician. The symptoms in these mild cases are those of minor and indefinite renal disturbance, accompanied in some instances by fever, which is dependent largely on the size of the foci or on the presence of mixed infection. Small quantities of blood and occasionally leukocytes appear in the urine, which also commonly contains albumin. In case drainage into the pelvis takes place, pus in greater or less quantity will appear in the urine and pus-casts are also apt to be found. When independent of general disease or other tubercular lesions, this class of cases gives little trouble as long as the general health is kept in good condition, and pathologists are perfectly familiar with frequent healed tubercular lesions in one or both kidneys without any evidence of renal disease being suggested by the clinical history of the case. This statement has been called in question, but our autopsy experience has led us to feel that it is well founded.

When the infection is of the ascending type and a tubercular pyelitis exists, the course of the disease is not to be distinguished clinically from that of an ordinary pyonephrosis, except as we may be able to demonstrate general tubercular lesions, foci of infection in the lower urinary tract, or when examination of the urine discloses the true nature of the infectious process. When drainage of the pus is free, as a rule, the temperature does not run high, the pulse is not accelerated, and but little indication of septic poisoning may be shown, and long periods may elapse during which no pus or tubercle bacilli appear in the urine. Many of these patients continue at their occupation without marked discomfort except when the ureters become more or less plugged by the necrosed tissue and pus-retention occurs. These cases may even continue on for a very long time with tubercle bacilli constantly present in the urine without causing reinfection of the bladder, provided always that care be taken to prevent overdistention or other secondary disease of this organ. The case-books of some of the older practitioners who have had the opportunity of observing kidney tuberculosis extending over a period of years are very interesting. The writers are indebted to the late Dr. George Chismore, of San Francisco, for the records of some cases of this description. Several of his patients have been able

to follow long and active business lives with relatively slight inconvenience.

Diagnosis.—As we have already intimated, diagnosis in cases of embolic infection can be made only with a certain degree of probability when, in instances of possible tubercular infection, renal disturbances, hematuria, albuminuria, and renal distress without the symptoms of nephritis appear. Where drainage of necrotic material or pus into the urine takes place, diagnosis rests on the detection of the tubercle bacillus in the urine. Renal tumor and tenderness are points of importance in some cases where other growths of the kidney may be reasonably excluded and where no other lesions accounting for the fever exist. In several such instances the writers have employed the tuberculin test with gratifying success, but it is very unreliable in those cases where septic conditions exist, and may confuse a possible reaction. We have thus far found the Calmette conjunctival and the dermal vaccination reactions unsatisfactory for diagnostic purposes. The leukocyte count may be of considerable differential value in some cases where mixed infection is not pronounced. Thus, in the purely tubercular disease no, or but a slight, increase in the total leukocytes is present and the differential count shows a relative increase in mononuclear elements, whereas in ordinary infections the polynuclear leukocytes are relatively increased.

The presence of tubercular lesions in other parts of the body is often strongly presumptive evidence of the nature of the renal process, but one must not allow himself to be overpersuaded in this direction, for we have frequently found that in such instances the renal lesions were nevertheless non-tubercular. Occasionally the *x*-ray shows suspicious shadows in cases of renal tuberculosis, which may greatly assist in diagnosis.

Where drainage of pus or recurrent or continuous hematuria is present, together with renal tenderness and tumor, the final test in diagnosis is the examination of the urine, which is of crucial importance in all types of the disease. Hematuria is notably less frequent and less profuse in the embolic than in the cases of ascending infection.

In ascending infection we usually are able to secure a history of

gonorrheal or other types of inflammatory disease of the lower urinary tract, and careful inspection may discover possible primary lesions in the testicle, epididymis, urethra, prostate, or bladder. In this class of cases the lesions are quite apt to be monolateral. In addition to these, we have the symptoms and signs of a pyonephrosis.

The recognition of the tubercle bacillus in the urine is by no means so simple a matter as may appear on the face of it, for other acid-fast organisms, morphologically similar to the tubercle bacillus, are not uncommonly found in the urine, especially in cases of pyonephrosis, and in our opinion the most careful microscopic examination in which the identification of the bacillus depends entirely on its tinctorial reactions is inconclusive unless backed by a typical clinical picture and by a definite morphologic identity. In every case of doubt—and most cases, in our experience, unless in the late stages, are of this nature—absolute identification can only be accomplished by inoculation of the questionable pus into the peritoneal cavity of a guinea-pig or other susceptible animal. A serious drawback to this procedure is that where mixed infections exist, as is commonly the case, the experimental animal will be killed by the secondary infecting organisms before the tuberculosis has sufficient time in which to develop. It is our practice to inoculate several animals with graded doses, and in case all survive two weeks, to kill the first after four weeks, a second after five weeks, and so on until full six weeks to two months has been allowed. The crucial test is the finding of tubercular lesions in the liver, spleen, and peritoneum of the experimental animal. Of course, there are many cases in which this procedure is unnecessary, but it is the only means to absolute diagnosis in many cases while they are still in a curable condition.

The use of antiformin has greatly facilitated the search for the tubercle bacillus in the urine, and it has at the same time rendered this important step more accurate in every respect.

The test is made by adding to the thoroughly centrifuged sediment of the urine an equal bulk of 30 per cent. antiformin solution. This is allowed to digest in the incubator at blood heat for from six to twelve hours, or until the greater part has gone into solution. This digestion may be carried on at room heat,

but a longer time is then necessary. The material is then again thoroughly centrifuged, and the fluid, having been poured or pipetted off, the remaining sediment is washed and centrifuged with decinormal salt solution until free from the antiformin.

The scant remaining sediment may then be spread on slides, fixed, and examined in the usual way, or it may be injected into experimental animals. The antiformin acts by digesting away most of the organic material except the tubercle bacillus, which if freed from the chemical, remains in a viable state.

This test is especially accurate, since it permits the examination of a much larger bulk of sediment than is otherwise practical. Dr. Felberbaum, at the Montefiore Home, has used this method extensively and highly commends it to us.

Evidence furnished by ureteral catheterization is often of great value, but the irritation from the insertion of the catheter may cause the first urine passed to be cloudy with leukocytes and blood, and may so mislead; furthermore, any mechanical irritation in these cases tends to inoculate new foci. Cystoscopic examination may show tubercular lesions in the bladder, the nature of which may be at once apparent.

Before making a cystoscopic examination in suspected cases of tuberculosis of the kidney, it is the custom of a German investigator to observe the case for several weeks; to wash the bladder with a silver nitrate solution, 1 : 10,000, three times; to examine the urine microscopically four or five times for the tubercle bacillus; and also to inject into two guinea-pigs the centrifugated sediment of the twenty-four hours' urine.

A conclusive diagnosis of tuberculosis of the kidney should never be made hastily.

Prognosis.—It would seem as though an earnest student with a fairly large clinical experience should be able to give a more definite prognosis in cases of renal tuberculosis than that expressed in the words of a well-known physician, "You can never tell"; but the more we see of the condition, the more conservative do we become in prognosis. Much depends on not only the willingness of the patient to submit to proper methods of treatment, regulation of the habits of life, but also on his ability to do so. The condition of allied viscera must be considered; where serious

general infection is present, the prognosis is obviously unfavorable, while where the general health is good and the lesion not advancing rapidly, it is more favorable, or perhaps entirely good. Every physician can call to mind cases of renal tuberculosis in which reasonable care has permitted the patient to live until he dies of some independent disease, and the number of cases which appear on the autopsy table in which completely healed tuberculosis of the kidney is seen attests amply to the fact that, at least in some cases, our prognosis should be favorable rather than otherwise. We wish to particularly call attention to this fact, since of late certain French surgeons have stated that healed tuberculosis of the kidney is never seen at autopsy.

Treatment.—We have in the past neglected too much the lessons which have been taught us in regard to the management of general tuberculosis when we come to apply them to cases of the renal disease. Outdoor life, bracing but equable climates, and good hygienic conditions are just as efficient in the treatment of renal as pulmonary tuberculosis, and there are no conditions advocated for the pulmonary disease in the hygienic or dietetic direction which may not with equal propriety be utilized in renal tuberculosis. Baths, well-regulated exercise, attention to the digestive functions, and even mental happiness are important factors in the management of these cases. We do not, however, strongly indorse the absolute rest treatment now so popular in the sanatorium management of general tuberculosis. Two cases of renal tuberculosis now under the care of one of us have apparently made complete cures under general hygienic measures only, and in both instances without long confinement to bed and the house. Both returned to their occupation as actresses inside of one year after the beginning of treatment.

But little is to be expected from medicinal treatment. Some urinary diluents or antiseptics may at times improve the condition of affairs, but such drugs as creasote, iodoform, and the like are to be avoided as doing more harm than possible good. We have personally met with no good results with tuberculin treatment, and we have finally come to rely on general medical and surgical methods, preferably of a conservative nature, associated with the best of hygienic surroundings, carefully supervised but generous diet, and a well-ordered and temperate life.

The writers do not advocate operative measures, especially when both organs are involved, except when distinctly surgical conditions, such as pyonephrosis, not amenable to medical or local treatment, are present. On the other hand, a tubercular pus cavity in the kidney is subject to the same surgical laws that govern the treatment of a like lesion in any other organ, and where symptoms of sepsis are developing or where drainage has ceased to be satisfactory the surgeon must operate. The type of the operation must, of course, depend on the conditions which he finds on the exposure of the diseased organ. In most tuberculous abscesses that are so extensive as to demand operative interference the kidney should be removed, provided that the associated organ is not also seriously involved. Partial nephrectomy in carefully selected cases may, perhaps, fully comply with the necessities of the conditions.

THE KIDNEY IN SYPHILIS

In an article on "Syphilis of the Kidney,"[1] one of the writers considered, somewhat exhaustively, the changes, properly attributable to syphilis, that are to be expected in the kidney. No evidence has been offered since that time to warrant a change in the views then expressed. Early syphilis is associated with renal hyperemia, just as occurs in the acute stage of other infectious diseases. In those cases in which lesions already exist, perhaps as the result of improper living or previous disease, the hyperemia may go on to the formation of true inflammatory or degenerative nephritis, which may even terminate in death, as in the case reported by Fordyce.[2]

Syphilis may cause an increase of connective tissue in the kidney, and interstitial nephritis is found associated with such frequency as to warrant the belief that it is the cause, at least in a certain proportion of cases. It probably acts primarily by setting up changes in and about the blood-vessels.

Amyloid degeneration of the kidney is regularly caused by

[1] Robert Holmes Greene in "Journal of Cutaneous and Genito-urinary Diseases," 1898.

[2] John A. Fordyce, "On the Occurrence of Nephritis in Early Syphilis, with the Report of a Case Terminating Fatally," "Journal of Cutaneous and Genito-urinary Diseases," 1897.

chronic syphilis. Both amyloid degeneration and interstitial hyperplasia, when due to syphilis, occasionally manifest a tendency to attack one kidney chiefly, or solely.

Gumma of the kidney, while rare, is now reported more frequently than formerly. They are usually confused with renal neoplasms, or less commonly with stone. Hematuria is a frequent symptom, as previously referred to. J. Israel[1] has reported two cases on which he performed nephrectomy in the belief that the palpable tumor which proved to be syphilitic was malignant; several similar instances have fallen under our personal observation.

Clinical experience in the treatment of syphilitic patients has led the writers to conclude that the condition of the kidneys should receive more routine attention in the treatment of this disease. It should be remembered that while mercury is of the greatest value in the treatment of syphilitic affections, the drug is, to a considerable extent, eliminated through the kidneys, where it may cause irritation, particularly if there is any preceding kidney lesion. On the other hand, true syphilitic changes in the kidney may be markedly benefited. There is no doubt that a true syphilitic inflammation or degenerative process may occur in the kidney, especially during the aggressive stages of syphilis. These are oftentimes entirely cleared by specific treatment, either with mercury or salvarsan, but these cases must be first carefully selected and studied, for we have seen cases of nephritis in undoubted syphilitics apparently killed from an acute exacerbation of the nephritis induced by the mercury or salvarsan. In a case seen in the writers' hospital service a kidney tumor half the size of the patient's head responded promptly to mercurial treatment. The growth had been variously diagnosed as tumor of the spleen and kidney. Catheterization of the ureters demonstrated the presence of pus in the urine of the diseased side, and the patient gave a history of syphilis ten years back and of tumor of the left testicle. Mercurial injections were followed by complete disappearance of the tumor in six weeks and return to perfect health.

Stimulation of the skin by means of baths and such daily exercises as will induce free perspiration, and so aid in relieving the dis-

[1] "Deutsch. med. Woch.," Jan. 7, 1892.

eased kidneys, is of benefit in these cases; otherwise the treatment is that of uncomplicated syphilis. Generally speaking, no operative procedure should be adopted for the relief of suspected tumor or stone, whether or not accompanied by hemorrhage from the kidney, until antisyphilitic treatment—*i. e.*, the administration of mercury or iodin—has been tried, though perhaps now that the Wassermann reaction has become so accurate, it is unnecessary to waste this valuable surgical time except in Wassermann positive cases. Although the symptoms present may be found but rarely to be due to syphilis, still when this is the case, the immediate improvement that follows this treatment is most gratifying.

Salvarsan is reported by some to have a very dangerous effect on the kidney otherwise diseased. The authors have had the opportunity of seeing a considerable number of cases treated by this drug, and usually no serious results of this nature have developed.

The arsenic so introduced is, of course, eventually largely excreted through the urine, and though resulting renal disease has been recorded, it appears to occur only in those cases abnormally sensitive to arsenic.

CHAPTER XII

MALFORMATIONS AND DISPLACEMENTS OF THE KIDNEY

CONGENITAL MALFORMATIONS

Congenital malformations of the kidney are comparatively common. They usually result from flaws in the very early development of the organ, and are of relatively little importance to the physician, though often very confusing to the surgeon, who may mistake them for new-growths, or whose anatomic relations may thus be grievously displaced.

Absence of one kidney is not a particularly rare condition. As a rule, in these cases (two of which have occurred in the writers' practice), the single organ is practically equal in weight, size, and in functional activity to those of the two organs of an ordinary subject of the same body weight. This congenital anomaly is also important chiefly to the surgeon, who may, in cases of surgical disease, remove the single gland in the belief that both organs are present, with, of course, an inevitably fatal result. The surgeon should, therefore, make it a rule of practice never to perform nephrectomy until he has proved, either by palpation or inspection or by the use of the cystoscope, that both kidneys are present, together with the relative degree of their lesions.

Congenital lobulation is a very frequent anomaly, but one that is of but slight importance. Ordinarily it is shown by a simple marking of the cortex, but in some cases it may be as complete as in certain of the herbivora. Occasionally, the separation of the lobules may be marked, and the lobules be entirely isolated. This last condition may lead to error in diagnosis, it being sometimes mistaken for renal or other new-growths.

Fusion of both kidneys into a single mass is not uncommonly seen. The most usual type of this deformity is that in which the two organs are connected by an isthmus of renal tissue, the whole forming a crescent-shaped mass that has received the name of

"horseshoe kidney." In this condition, as a rule, both ureters are present (see fig. 87), but occasionally there may be but one excretory duct; in either case its recognition is of but slight importance.

Congenital malpositions of one or both kidneys are not uncommonly seen. As a rule, they have but little importance clinically, although in certain cases, as was noted by Osler they may seriously complicate diagnosis. Occasionally, by impinging on other organs, they may give rise to disease. This is particularly true of pelvic kidneys when pregnancy occurs. In a case occurring in the service of the writers, both kidneys were congenitally misplaced in the pelvic cavity; acute nephritis with fatal uremia followed a twin pregnancy. The woman had passed through a previous single pregnancy without trouble, but in the twin pregnancy the greatly enlarged uterus so compressed one of the misplaced organs as to produce actual strangulation and gangrene with acute nephritis of the other kidney. The condition was not suspected and was discovered only at autopsy.

Fig. 87.—Horseshoe kidney (one-third natural size). From a specimen in the Museum of Carnegie Laboratory.

One of the most common and important congenital anomalies is that of **cystic kidney.** Occasionally but a portion of one kidney is so involved, but at times both are affected. The condition results from the failure of the two portions of the fetal

anlage to unite properly. One of these portions, representing, in the fetus, the anlage for the pelvis and medulla, is developed from the Wolffian duct; the tubules formed in the intermediate cell-mass of the metanephros should eventually fuse with those of the portion derived from the Wolffian duct. Secretion of a more or less normal nature goes on in the blind tubules, with the result that they become dilated into cystic cavities filled with inspissated secretion. The writers believe that this is the mode of origin of many of the isolated cysts of the kidney seen postmortem,

Fig. 88.—Congenital cystic kidney (one-third natural size). The accompanying organ was similarly diseased and both had been removed surgically as supposed cystic ovaries. Acute suppression of urine followed, terminated by death after three days. No symptoms indicative of renal disease had been manifested and the urine was reported as "normal." Specimen from the Museum of Carnegie Laboratory.

but it is not rare to find the entire kidney substance involved and the organs forming tumors of very large size, the nature of which may not be suspected even on ocular examination. It is astonishing, as shown in the case illustrated in fig. 88, to what an extreme degree this cystic change may exist and yet the kidneys remain competent to fulfil their function. In the case illustrated, practically no trace of normal renal tissue could be found, and yet the patient reached adult life, death occurring as the result of anuria

following removal of the cystic organs in the mistaken belief that they were ovarian tumors. Before removing cystic tumors of the abdominal region it is well, therefore, first to ascertain whether or not they constitute the only renal tissue of which the patient is possessed. Congenital cystic kidney is usually seen in monsters, and marked cases rarely live beyond infancy. The condition is not infrequently associated with sarcomatous growths.

Anomalies in the arterial supply of the kidneys are very frequent, but are of interest chiefly to the anatomist.

MOVABLE AND FLOATING KIDNEY

It is a well-known fact that the kidneys are normally more or less mobile, the movements being somewhat dependent upon the amount of perirenal fat present. This amount of fat varies, of course, in different individuals, and in the same individual from time to time. The term "floating kidney" is applicable to those cases in which the movement of the kidney has gone beyond the physiologic limits; just what these physiologic limits are is, however, a very difficult matter to determine, the personal equation of the observer playing an important part here. For example, a physician whose belief it is that a great many ills are dependent upon floating kidney would naturally be led to regard as a displacement or as excessively mobile, an organ that another observer, of a more conservative type, would consider entirely within the normal, or, when displacement actually had occurred, would regard the matter as of no great importance.

Pathology.—Some movable kidneys are said to move inside of the fatty capsule, from the absorption of fat between the true kidney surface and the fatty capsule. Still another class is believed to be abnormally mobile, owing to the absorption of fat from both inside and outside the capsule. In women, tight lacing has by some been held to be one of the reasons why the kidneys are more often displaced in females than in males. Unquestionably the relaxation of the abdomen following certain pregnant states also predisposes women to this condition, and the lowering of intra-abdominal pressure following relief from large tumors or even the aspiration of ascitic exudates may bring about the same result. There are also a certain number of cases which develop

after blows or injuries to the back or sides, and still more rarely one occasionally may see other traumatic cases following severe falls. The condition is almost always present in general enteroptosis.

The term "displaced kidney" is more properly used to describe those cases in which the kidney remains quite permanently misplaced, while "floating kidney" should not, in our opinion, be

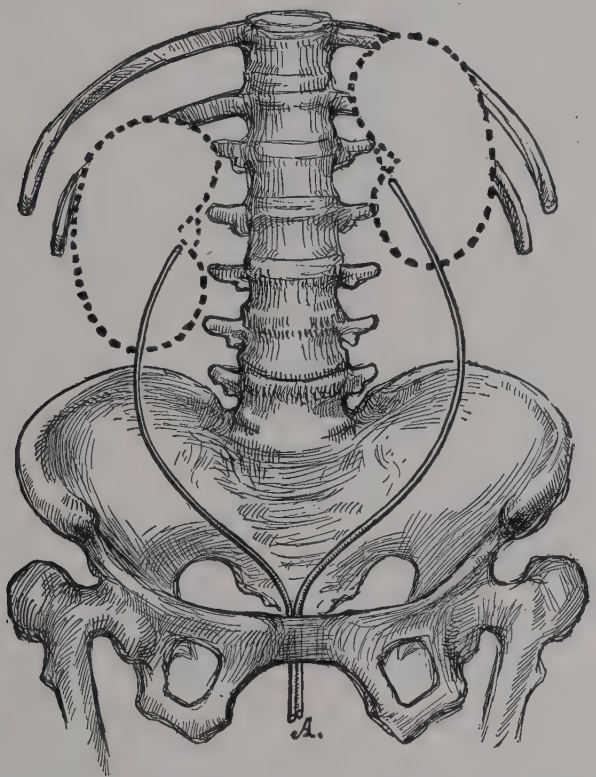


Fig. 89.—Diagram made from *x*-ray photograph, showing metal ureter-catheters (*A*) in position, and indicating how a displaced kidney may be diagnosed. The kidney on the right side is displaced somewhat.

applied unless the organ drops a considerable distance from the normal.

Diagnosis.—It would be impossible to describe here all the symptoms of which floating kidney is said to be the origin. It has been discovered that many of these cases are associated with neuras-

thenia, and the symptoms of the two conditions cannot be wholly separated. Albarran asserts that floating kidney uncomplicated by any inflammatory lesions in or connected with the urinary tract, and when free from pressure, will not cause systemic disturbances. We consider this statement as too general to be universally accepted. Typical cases manifest a symptom complex known as "Dietl's crisis," which consists of sudden attacks of pain in the back and loin, accompanied by nausea, vomiting, and suppression of urine, followed, after a few hours, by the expulsion of a large amount of urine and immediate relief from pain. These painful attacks are believed to be due to pressure on, or to a kink in, the ureter, brought about by a displacement of the kidney; relief of this obstruction allows the urine dammed back in the pelvis of the organ to be discharged.

Malignant diseases of the kidney, ureter, or surrounding tissues are hard to differentiate in some cases, as they also give rise to similar attacks. Differential diagnosis must largely depend on discovery of the malplaced organ by palpation and by rectal or vaginal examination. An *x*-ray taken with a metal ureter catheter in position, as shown in our illustration (fig. 89), will in cases of doubt definitely establish the diagnosis. Our illustration is taken from a case of this description. The writers' experience with cases of displaced kidney has led them to adopt a rather conservative view regarding the amount of disturbance ordinarily produced by lesser displacements.

Treatment.—Given a patient who manifests Dietl's crisis, it would seem evident that some procedure should be adopted to correct the displacement in the hope of affording relief from these distressing symptoms. Many cases are doubtless cured by the persistent use of a properly fitted corset or support, or by the combination of this method with such general measures as tend to deposition of normal adipose about the organ, thus tending to retain it in position. Where such measures fail, and they usually do in pronounced cases, operation may be imperative. We do not, however, advise operation merely upon the diagnosis of displaced kidney when distinct symptoms of disturbance are wanting and where less aggressive measures suffice. The operation should not be done so much to correct the displacement as to attempt to

relieve the obstruction to the ureter, which may, of course, be also due to causes other than kidney displacement.

In a very large proportion of the many operations performed in this country for the fixation of a displaced kidney, the symptoms complained of have been those that are generally considered as indicative of neurasthenia, and the operation has been performed in the belief that the displaced kidney was the cause of the neurasthenia. In a case that came under the observation of one of the writers several years ago the patient, a young woman, was believed to be suffering from tuberculosis of the kidney. The right kidney was well down in the pelvic cavity, and was easily palpable. The patient was thin, and it was seen that the organ was most markedly displaced. The woman was of a nervous, impressionable type, and her mind seemed to dwell on the subject of tuberculosis of the kidney with such persistence that it had become a fixed idea in her mind. When she was told that no indications of tuberculosis had been found, she was skeptical, and sought the advice of a well-known practitioner, who subsequently removed one of her kidneys. Curiously enough, however, he removed the left kidney, allowing the right kidney, which, as previously stated, was markedly displaced, to carry on the work of excretion. So far as has been learned, the result on her mental condition has been negative, but her general health is still good.

In most cases seen by the writers in which appliances of an orthopedic type were beneficial, the patients were of the neurasthenic variety, and it is doubtful whether the kidney displacement was in itself the cause of the symptoms complained of. The writers believe that displaced kidneys may be anchored in place with little or no danger to the patient. Permanent replacement is afforded only as the result of the operation of nephrorrhaphy, though general medical treatment, especially when designed to increase the perirenal fat, as well as to relieve annoying symptoms, may give great and even permanent relief.

HYDRONEPHROSIS

Hydronephrosis is a condition, the general importance of which has been recognized by most practitioners in a more or less indefinite way for a long time, but the discussion of the subject, except in

its bearing on other disorders of the urinary passages, has been mostly confined to works on pathologic anatomy, and the clinical appreciation of its importance has been very generally underestimated, and is as yet but very inadequately discussed in some works dealing chiefly with the clinical sides of diseases of the urinary organs. Pathologic anatomists are universally familiar with the subject, both because of its frequency of occurrence at the autopsy table and also since it explains, in a very considerable number of cases, the appearance of definite signs and symptoms in the development of many diseased conditions of the kidney and ureter.

Pathologic Anatomy.—The pathologic anatomy of hydronephrosis is very simple; briefly, it consists of a dilatation of the pelvis of the organ by urine. The variations in the pathologic anatomy are chiefly those of degree, and to a certain extent the degree of the lesion is dependent on the length of time which the condition has persisted and the nature of secondary changes which may have taken place, either as secondary or concomitant lesions.

In slight instances, the lesion may consist of little beyond simple dilatation of the pelvis of the organ, usually with more or less erosion and desquamation of the pelvic epithelium. When the change is more pronounced, the calices of the pelvis are widely dilated and excavated and replacement of the pyramids is shown. In very pronounced cases the organ may be greatly increased in size—so much so as to be readily palpable. In such examples renal tissue is reduced to but a narrow rim of cortex lying beneath a greatly thickened limiting capsule of connective tissue (fig. 90). Cases are often seen in which practically all renal parenchyma is so replaced, and one only wonders that life can have persisted, for occasionally even these pronounced lesions are bilateral.

Etiology.—The condition is brought about in all instances by the mutual occurrence of obstruction to the urinary outflow and continued secretion by the organ on the obstructed side. Complete obstruction, especially when of acute origin, is much less apt to produce the condition than incomplete or slowly developing obstruction, since where the obstruction is acute or acutely complete, the increased intrapelvic pressure soon balances that in

the capillaries of the obstructed organ, and circulation is slowed and decreased and secretion finally completely checked. The condition is much more apt to appear where partial escape of the urine is possible, but as a result of which the intrapelvic pressure is persistently increased, yet not so completely so as to stop secretion. The disease is, therefore, seen most frequently in such cases as show a gradually and slowly increasing obstruction to urinary outflow.

The condition may be classified as congenital and acquired.

Fig. 90.—Hydronephrosis following monolateral stricture of the ureter (authors' specimen).

Congenital hydronephrosis is seen as a result of incomplete or abnormal development of the urinary tube, as a result of the precipitation within the urinary passages of urinary salts, or from compression from abnormally placed viscera or vessels. A striking example of the first-mentioned condition was recently shown us by B. S. Crowell. The specimen was from an infant which it was found impossible to deliver after the head had fully descended. Finally, it was found necessary to do embryotomy, and examination of the dismembered fetus showed enormous distention of the abdomen and great general edema of all the

tissues. The abdominal tumor was found to consist of the two tremendously distended kidneys, the urine from which had been unable to pass into the bladder on account of almost complete congenital stenosis of the ureters. This lesion was found associated with other but irrelevant congenital defects.

Obstetricians and pediatrists frequently see cases where either no urine or one very richly charged with precipitates of salts or of free uric acid is present, and in such cases more or less obstruction results. In a notable number of instances this obstruction is in the urethra in both female and male infants, and proper manipulation may at once relieve the condition. In these cases colloidal substances, found so richly in the urine of recently born infants, of course, predispose to the precipitation.

Acquired hydronephrosis may follow obstructions within the urethra, such, for example, as stricture from the lodgment of stone, from the formation of inflammatory or neoplastic tumors. Needless to say, the most frequent cause of urethral obstruction is stricture, and the relative percentage of cases of marked stricture in which hydronephrosis develops is large.

Prostatic obstructions are, perhaps, the most frequent cause in elderly men, and here also the growth of tumors or lodgment of stone must be considered in the eliminative discussion.

Cystic lesions leading to hydronephrosis are chiefly of inflammatory or neoplastic origin. New-growths in the region of the ureteral mouths or inflammatory or tubercular disease at the entrance of these ducts are among the more frequent causes, while occasionally the lodgment and encysting of a calculus in this region effects the same result. Thus far the lesions concerned in the production of acquired hydronephrosis are relatively easy of determination by any careful physician, especially for one skilled in the use of modern instruments of bladder search, but the remaining causative factors can be only problematically diagnosticated except by abdominal exploration or by the use of ureter catheterization.

Such, for example, are obstructions to the ureters. The most frequent ureteral lesion productive of hydronephrosis in our experience has been the kinking of the tubes in cases of malplaced or floating kidneys. Compression by tumors, either inflammatory

or otherwise, and either within or without the ureters, is also found relatively common. We have thus found the condition to originate in cases of tubercular peritonitis or even after bands of adhesions following peritonitis or operative adhesions. It was shown in a recent case of Hodgkin's disease, occurring in the service of one of us, where the pressure resulted from the greatly enlarged lymph-nodes about the ureters. The lesion is frequent in cases of pelvic tumors and inflammations, especially in women and in cases of appendicitis characterized by adhesion or marked fibrotic formation. The obstruction to the ureters following careless application of abdominal ligatures in peritoneal surgery has been generally noted. Stone lodged in the ureters forms an exception to the general rule as regards ureteral obstructions, since in the majority of cases the symptoms are sufficiently characteristic to permit of absolute diagnosis. Strange as it may seem, stone lodged in the renal pelvis rarely causes these conditions. Abdominal tumors, and especially pelvic growths of all varieties, are very prone to produce hydronephrosis, and from the relatively greater frequency of these lesions in women hydronephrosis has been reported by Albarran to be most common in this sex.

One factor, important because it is so commonly ignored in the etiology of hydronephrosis, is the frequency with which the condition occurs as a result of the retention of urine due to mental or habit disturbances. We have often seen the condition in those moribund or ill with spinal or cerebral disorders in which the sensations of an overdistended bladder were not appreciated. It has been found common thus in hospitals, where proper catheterization of dying or comatous patients was neglected, and the frequency with which this lesion arises, especially in alcoholism, diabetes, and uremia, should be borne in mind by every practitioner.

We have, furthermore, found hydronephrosis common, especially in young women working in offices who, from feelings of delicacy or from downright physical laziness, do not attend to their bladder functions at regular or sufficiently frequent intervals. In our opinion, with which a prominent gynecologist coincides, this factor is one of the most frequent concerned in the production of ill health, and especially of the backaches which are so commonly complained of by young women.

The most serious **results** of hydronephrosis are dependent upon nephritis, either in the involved organ or in cases of monolateral disease, a compensatory nephritis in the other kidney, and secondary inflammatory disease, especially pyonephrosis. Concerning the relationship to this last-mentioned condition, sufficient mention has been made under the head of Suppurative Diseases of the Kidney (page 184).

The **symptoms** of hydronephrosis are those of the obstruction, such, for example, as the colic which follows lodgment of a stone in the ureter or urethra, or of the pressure from enlarged lobe of the prostate or from a tight stricture, and those symptoms proper of the dilated and isolated kidney.

Backache is one of the most constant of these symptoms. Slight febrile manifestations may be present even in some non-infected cases. Where a palpable tumor is present, tenderness is usually present over it, and at times massage, gently performed, may cause the evacuation into the bladder of a urine, light in specific gravity, accompanied by reduction in the size of the renal tumor.

Diagnosis depends first on the recognition of conditions which might induce hydronephrosis, for example, a tight stricture, probable lodgment of a calculus, or detection of a floating kidney. In this step instrumental examination with the sound and cystoscope and the employment of ureteral catheterization may serve clearly to establish the diagnosis. It must not be concluded, however, where a ureteral catheter cannot be passed, even by a skilful operator, that obstruction of sufficient degree necessarily exists to cause a hydronephrosis, since the stricture may be due but to muscular spasm. Obviously, palpation of a renal tumor is possible only in pronounced cases, and the absence of definite renal tumor must never be taken as negativing the diagnosis of hydronephrosis. When, however, massage of a renal tumor causes the descent into the bladder of a urinary fluid with corresponding reduction in the size of the tumor, the diagnosis seems to be clear and decisive, except in some cases of cystic kidney, where this sign may also appear. Where the condition is monolateral, cystoscopy, with the consequent demonstration, with or without catheterization, that fluid escapes but from a single side may be diagnostically important. The symptoms of the condition, except as

they indicate obstruction in some portion of the urinary tube, are of but little assistance in diagnosis, largely because of their indefinite nature and very inconstant appearance.

Treatment.—Treatment should be first prophylactic. In all operative procedures on the urinary tube care should be taken that nothing is done which causes compression, even of relatively slight degree, of the passage. The importance of this step, especially in pelvic surgery, needs but mere mention. Wherever any obstructions in the passage are present which are liable to become more marked, they should receive immediate treatment. In the early stages even unskilful massage along the course of the ureter may dislodge a stone; cauterization of an ulcer at the urinary papilla, with subsequent appropriate treatment, may prevent the formation of a cicatrix likely later to cause stricture and hydronephrosis. We should especially like to call the attention of the practitioner to the necessity of proper and early dilatation of urethral strictures, and to the early relief of cases of prostatic hypertrophy which is accompanied by a high intra-urinary pressure. Finally, we believe that it is very important to strongly advise in all cases regular and habitual evacuation of the urine at sufficiently frequent intervals, for we are convinced that negligence in this matter is responsible for hydronephrosis in a very considerable number of cases.

Curative treatment necessarily lies chiefly along surgical lines. True, in some cases, very simple measures, such as the replacement of a dislodged kidney, may effect a cure, or massage and manipulation dislodge a stone, but wherever actual physical obstructions exist, they should, in all cases, except those manifestly moribund, be removed as early as possible. It may thus become necessary to open into the pelvis for the removal of stone, to fix the kidney where displacement cannot be relieved by less drastic measures, to release the ureters from cicatrizing adhesions, to enucleate cystic tumors, or to dilate or cut strictures.

Where such relief is impracticable or impossible, it may be necessary to open the tumor and drain externally. In cases sufficiently marked to demand such measures, as a rule, secretion is very slight in the diseased kidney and the organ generally contracts down with absolute cessation of secretion, so that the external

drainage of urine is not often a permanent nuisance. Cases have been reported where it was necessary to implant the ureters either to another position on the bladder, to unite them with the gut, or transfix them in the loin. The precise step in each case must be decided by the conditions present, and good surgical judgment is as indispensable here as in most operative procedures on the urinary organs. The precise method employed must generally be selected in the midst of the operation, and the ingenuity of the operator may be severely taxed to produce the best possible result. Two things of importance must be remembered: whatever is done should be done as early as possible, and before closing the wound the surgeon should be certain that all other portions of the tract are clear from obstructions, especially in cases of stone. This can be readily determined by the injection of sterile salt solution, preferably colored, which can be readily recognized as it appears in the bladder or from the urethra. For a detailed description of the surgical procedures strictly applicable to the relief of hydronephrosis, reference is made to the chapter on the Surgery of the Ureter, and for the Relief of Retained Renal Secretions.

CHAPTER XIII

WOUNDS AND INJURIES OF THE KIDNEY

WOUNDS OF THE KIDNEY

Wounds of the kidney are most generally due either to a knife-thrust or to a bullet; more rarely they are the result of a fall on some sharp instrument. When a wound of the kidney is very large, a hernia of the kidney will take place into the wound. The condition is readily diagnosed. Ordinarily, the kidney is very tolerant of wounds, and if the knife or bullet that inflicted the injury was clean, healing is generally rapid.

Wounds of the kidney are, as a rule, accompanied by more or less shock; it should also be remembered that internal hemorrhage may take place and be so severe as to cause death before operative procedures can be resorted to. A chemical examination of the blood coming from a wound in the kidney region will demonstrate the presence of urine. A tumor in the loin may or may not be present. If there is a free discharge of blood in the urine, the tumor will not occur. Careful examination should be made to see that no foreign bodies have been carried into the wound. Pain similar to that of renal colic is apt to be associated with wounds of the kidney. Hematuria is associated with most wounds of the kidney. As sequels may be mentioned peritonitis, suppuration of the kidney, cystitis, and, after healing, rheumatism, neuralgia, and contraction of the muscles.

The **prognosis** as regards wounds of the kidney should be guarded. In a series of 38 wounds of the kidney inflicted by sharp instruments, 42 per cent. died. Gunshot wounds of the kidney are more likely to result fatally than those made by cutting instruments. The prognosis is not necessarily as serious from the wound itself as it is from the fact that they are so often associated with injury of other organs, and the impossibility of telling how much infection is carried into the kidney by the wound-

making agent. These wounds of the kidney are apparently becoming more frequent, in this city at least, stiletto wounds being the most common type. The attached illustration (fig. 91) represents the ordinary appearance of a stiletto wound in the kidney, the patient dying from wounds through some of the larger blood-vessels, in addition to those of the kidney. It is important to note that wounds inflicted by modern high-power weapons are

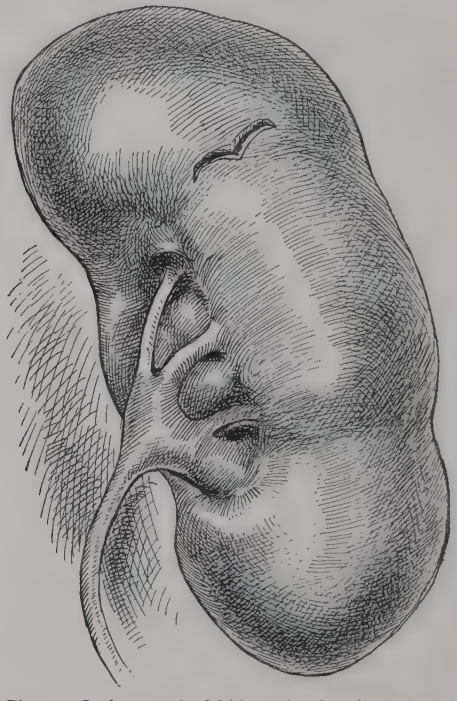


Fig. 91.—Stab-wound of kidney (authors' specimen).

quite different from those of the old black-powder guns. At short range the modern projectile causes either a small clean-cut wound, with little hemorrhage, or else a blasting effect, with extensive laceration; at long range, a wound small and clean cut generally results; in either case the wound is generally aseptic.

The **treatment** of kidney wounds, when they are at all extensive, is surgical. The operative procedures are dependent upon whether the wound has involved the peritoneum or has only injured the kidney outside of it. In wounds inside the peritoneum, laparot-

omy should be performed; in those outside the cavity, an incision should be made in the lumbar region and the kidney exposed. In either case hemorrhage should be checked, the kidney wound rendered aseptic and sutured, and good drainage established. It is not always easy to thoroughly clean the retroperitoneal space of any extensive hemorrhage which may have taken place. In such cases especial care should be taken to see that thorough drainage is established. Wounds of considerable extent should be tamponed instead of sutured. The same conservatism as regards operation should be shown for wounds as for general injuries of the kidney, and nephrectomy should be considered as the operation of last resort.

INJURIES OF THE KIDNEY

The causes of injuries to the kidney are various. They may be due to a blow on the abdomen or to strains caused by lifting or jumping. Now that automobile accidents are becoming so frequent, injuries to the kidney may be expected to increase in a corresponding degree. Curiously enough, a spontaneous rupture of the kidney may occur from the bursting of a tumor, two cases having recently been reported by Tuffier and Hartmann.[1] The subject of subparietal injuries to the kidney has been must carefully studied by Francis S. Watson, and a most exhaustive and valuable contribution to the literature of the subject made by him.[2]

Symptoms and Diagnosis of Injury of the Kidneys.—Following a severe injury of the kidney, if recovery from the shock has taken place, pain in the renal region is likely to follow. This pain resembles that caused by a stone in the kidney, and in the male radiates down the abdomen into the testicle. The pain sometimes disappears soon after the injury, to return in the form of nephritic colic, which vanishes when a clot is passed. In addition to the pain, the most constant symptom is hematuria. Blood which coagulates in the ureter often passes out in angleworm formed bodies. Such molds in the urine are diagnostic of hemorrhage high up in the urinary tract. More or less swelling in

[1] "Revue de Chirurgie," 1905.

[2] "Subparietal Injuries to the Kidney," "Boston Medical and Surgical Journal," 1905.

the neighborhood of the injured kidney is generally associated with the pain and hemorrhage. When the swelling is very marked and diffuse, hemorrhage and urinary infiltration are probably taking place outside the kidney; but if the swelling is more firm and circumscribed than that just described, filling the kidney space, a hemorrhage inside the capsule of the kidney may be suspected.

Ecchymoses are likely to form on the surface of the body at the seat of the traumatism. At times these do not appear until several days after the injury has taken place. If they appear in the lumbar or inguinal region, they are believed to possess some diagnostic value. The urinary secretion is frequently disturbed, the quantity of urine excreted being probably diminished. Ureter catheterization is a valuable aid in determining the seat and extent of the injury. Recovery is usually rapid from the injury when the kidney surface has not been torn through. Even when the parenchyma has been torn, the kidney manifests a tendency toward repair. In the gravest cases death from internal hemorrhage or shock is likely to be immediate. In mild injuries the pain disappears and the trifling hemorrhage ceases in about forty-eight hours. In severer cases the hemorrhage is more extensive, there is a marked diminution in the quantity of urine excreted, and a swelling is apt to appear in the lumbar region. When the contusion is extremely severe, the kidney may be so lacerated as to resemble a pane of glass through which a stone has been thrown—there are fissures running in all directions. Such severe injuries are almost invariably fatal. Injuries of the kidney, if not too extensive, have a tendency to heal spontaneously, but often manifest unpleasant after-effects. It is possible that an injury to the kidney so slight as almost to be overlooked may later give rise to the formation of multiple abscesses, a single abscess, a cyst, or a calculus, or it may serve as the starting-point for a growth of the kidney. There is a tendency on the part of the profession to pay too little attention to the serious after-results of kidney injury.

Injuries of the kidney are not infrequently the cause, particularly in women, of displaced kidney. They are often, through injury to the ureter or the kidney pelvis itself, the cause of a hydronephrosis. Particularly serious are injuries to the kidney if the accident occurs in kidneys that are not in normal state. Neu-

man[1] states that he has seen pyonephrosis, pyonephritis, pyocystic kidney, ureteritis, hydronephrosis, and papillary cystoma of the kidney from injury. With the first three conditions he believes gonorrhea to have been the exciting cause, and injury to the kidney the contributing cause. Some very interesting experiments concerning the effect of an injury to one kidney upon the neighboring kidney have recently been made on dogs by Castaigne.[2] Briefly, he found that a renal contusion caused for a time a diminution in the total diuresis and sometimes abolishes it for twenty-four hours or more. That later on the after-effect on the uninjured side from a transmitted lesion of the other side was to cause a condition of sclerosis in the well kidney, intermingled with hypertrophic zones. He seemed to attribute the condition which took place in the well kidney to the effect of the absorption of kidney toxin from the diseased organ. There is considerable clinical evidence which tends to support the views of Castaigne, obtained by him from his experiments on animals. Anuria through some reflex nervous influence following injury to the kidney has been noticed. Also, particularly by the German school of observers, has a form of nephritis, called traumatic nephritis, been noticed to occur several months after an injury to the kidney, the injury apparently being the only causative factor. This traumatic nephritis is stated by at least one observer to be a mixture of a parenchymatous and interstitial nephritis; his views are also corroborated by the very valuable work of Beers, of New York, referred to earlier in the article on Tests of the Permeability of the Kidney, his researches tending to show that there was increased functional activity in the better kidney following the removal of a diseased one.

The **prognosis** regarding injuries to the kidney should naturally be guarded. Not only should it be guarded as regards the immediate effect of the injury, but for its later after-effects, and necessarily it is often rendered more difficult by injuries to the neighboring organs. Particularly should the prognosis be guarded if there is any previous history of disease in the kidney, an injury naturally tending to make any previous abnormal condition worse.

[1] "Zeitsch. f. Chir.," 1906, No. 9.
[2] "Gazette de Hôpitaux," October, 1906.

The **treatment** of injuries of the kidney must be varied according to the nature of the case. Not infrequently the shock following injuries to the kidney is so severe that the patient dies, although no other organ was involved; one of the writers saw a case of this kind at autopsy; in suspected injury of the kidney the ordinary treatment for the relief of shock should be therefore instituted. A careful examination should then be made. In a suspected case of injury to the kidney, if the recovery from shock is rapid and blood soon disappears from the urine, the kidney again assuming its functions, little is required beyond rest in bed, the application of an ice-bag to the injured region, and the administration of a urinary antiseptic. The patient should be kept under constant observation, so that operation may be performed at once if untoward symptoms develop. After the patient has so far recovered from the injury as to be able to be up and about, he should not be dismissed from observation, but should be examined at intervals for some period of time, so as to detect any tendency toward the formation of untoward after-effects.

If the hemorrhage continues and a marked swelling appears in the lumbar region, an exploratory incision should be made and the field of injury carefully inspected. It is best, in doubtful cases, to make an incision and examine the kidney. Such further steps may then be taken as the exigencies of the case would seem to indicate. Particularly should the presence of any tumor in the loin be looked for and observed; it having appeared, it should be watched carefully for a few days, and if no tendency to absorption and no amelioration of the general symptoms have appeared, operative procedures should be instituted. The operation may vary from tampon and suture to nephrectomy, varied according to the conditions found to be present, or which may develop. Nephrectomy should always be the operation of last resort in uncomplicated cases, and in some cases at least, if required, should follow a more conservative operation. The injuries of the kidney offer a particularly good field for conservative surgery. This is borne out by the statistics of Watson in his paper, previously referred to, and very recently other cases have been reported which tend to confirm this view. For instance, Chaput [1]

[1] "Revue de Chirurgie," 1905.

sutured a ruptured kidney which had a fracture extending the entire length of the anterior surface; he put a drainage-tube into the pelvis, and blood passed through the incision for three weeks; hemorrhage then ceased, and perfect cure resulted.

Partial resection of the kidney may be performed upon a ruptured kidney. A. L. Franklin reports a most remarkable case.[1] A sixteen-year-old girl felt something give way after a fall from a wagon. Pain, vomiting, and hematuria followed; then a state of gradual collapse. Operation eighteen hours after the accident—laparotomy; the left kidney was found torn to pieces, and the right kidney had three transverse tears; the left kidney and three-fifths of right kidney were removed. Six months later the patient was well and excreted normal urine. Another interesting case has been recorded by Chaput, in which a large portion of the kidney had to be removed following injury, and in a few days the part of the remaining organ was taken out and found to have hypertrophied to a considerable extent. These two cases, narrated above, also tend to demonstrate that the views advanced from experiments on animals are corroborated by clinical observations on man.

[1] "Rupture of Both Kidneys," "American Journal of Surgery," 1906.

CHAPTER XIV

RENAL CALCULUS

Under certain conditions stones are formed within the urinary passages. Calculi develop for the most part in the kidney, but they may be found in any of the urinary passages into which they have subsequently entered, where they may either be loose or become encysted.

Pathology —One of the chief causes of the formation of renal calculi is the presence of insufficient fluid in the urine to hold the various organic and inorganic constituents that are normal to it in solution; they therefore become precipitated when the fluids of the urine are reduced and become abnormally saturated with these chemic substances. This condition may arise when the amount of fluids furnished the body is deficient, or when, as in excessive purgation or diaphoresis, the amount of fluid normally excreted through the kidney is diminished. The familiar appearance of calcium oxalate crystals under certain dietetic conditions, or associated with excessive perspiration, is a common example of such a state. The same result may follow when the chemic character of the urine is altered, causing interaction and the precipitation of certain bodies, either normally or abnormally present in the urine. Thus excessive acidity of the urine may cause the precipitation of uric-acid crystals even though uric acid exist in but normal amounts. In these respects the vital temperature acts very much as heat does outside of the body, tending to prevent precipitation to a certain degree, and to hold the salts in solution better than after the urine has been allowed to cool.

Rainey, Ord, and Carter have shown, by an elaborate series of experiments, that certain bodies in the urine, such as various gums, albumins, and colloidal substances, also tend to cause precipitation of the salts of the urine; these do not, however, appear in a crystalline form, but in a condition that they term submor-

phous, and in which the precipitated particles, partly for mechanic reasons, adhere to one another.

Certain foreign chemic bodies, taken in with the food or drink, also tend to cause a deposition of the urinary salts; thus Prout, Cadge, and others assert that this takes place when the so-called hard drinking-waters are used, in this way accounting for the frequent occurrence of renal calculi in certain districts, as in some of the counties in England.

In some conditions associated with disordered metabolism the urine is called upon to excrete either abnormal substances or normal substances in abnormal quantities, and in the course of this excretory process the material may become deposited in the renal tissues. This is well illustrated in certain cases of osteomalacia, when the breaking-down of the bony tissue causes the deposition of lime-salts in the tubules of the kidney.

Gross foreign bodies within the urine, particularly those of a sticky or albuminous nature, seem to act as exciting causes; thus the ova of parasites, echinococcus hooklets, broken-down tubercles, or portions of necrotic tissue originating from neoplasms, pyonephrosis, or other inflammatory and hemorrhagic diseases of the kidney, tend to the accumulation of urinary salts and the formation of calculi. This complication is particularly likely to arise in suppurative processes in the pelvis of the kidney.

It is believed by some that malnutrition predisposes toward the formation of renal calculi, since kidney stones are found most frequently among the poorly nourished. This theory has not, however, been sufficiently substantiated.

The chemic substances that go to make up these renal deposits vary under different conditions and are dependent upon the etiologic factor. Undoubtedly, the most common constituent is uric acid, generally in crystalline form. Calcium oxalate, phosphate, and carbonate calculi are common, and when alkaline fermentation has taken place, ammoniomagnesium phosphate calculi occur. Xanthin, cystin, and other rare chemic bodies are also occasionally the chief constituents of renal calculi. Sodium urate is one of the more frequent types of calculi, particularly in gouty subjects. As a rule, however, calculi are made up of mixed chemic substances.

The gross appearance of the stone varies, naturally, according to its chemic constituents, and although most calculi contain more or less mixed substances, the predominating chemic body generally gives a more or less distinct appearance to the calculus. The size of the calculi varies: they may appear in the form of a dust-like powder, or may attain a size sufficient to fill the entire renal pelvis or perhaps to erode the tissue of the kidney and replace it with the mass of the calculus. The size and shape of the cal-

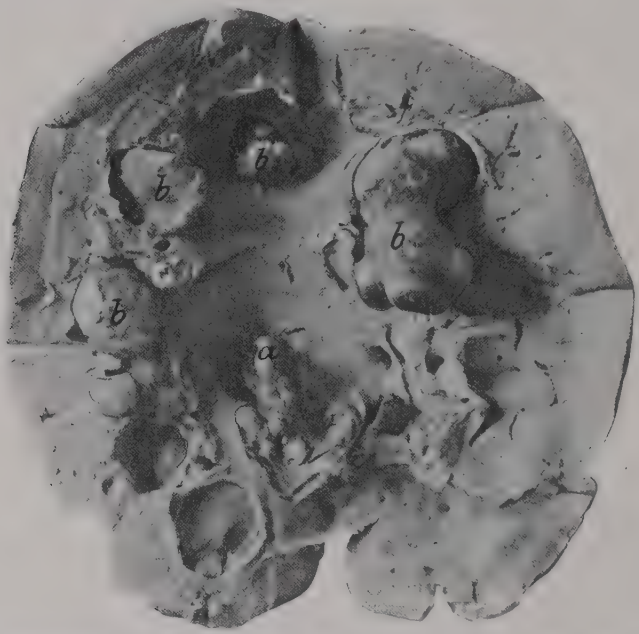


Fig. 92.—Kidney showing calculi lodged in the calices of the pelvis (natural size). From a specimen in the Museum of Carnegie Laboratory.

culus depend largely on the portion of the kidney in which it is lodged, or on its etiology; thus the dust-like powder is most common in those cases of purely chemic origin.

Calculi may be found in the renal tubules or in the interstitial framework of either the cortex or medulla or in the pelvis.

Stones found in the substance of the cortex or medulla are most frequently of the fine granular variety and occur most commonly in the form of sand-like deposit in the cells of the tubules of the medulla. They are generally composed of uric acid or of urates,

and are most prevalent in gouty subjects or in children from two to fourteen years of age. The condition is known as uric-acid infarction. In early infancy the urine will frequently be found to be literally loaded with uric acid and urates. Postmortem the deposit is found present in the tubules of both medulla and cortex, but more abundantly in the former, or perhaps entirely covering the mucosa of the pelvis. In these cases acute suppression of urine, followed by death, occasionally takes place. In uremia and in some other diseases the ureters may be found occluded with the material; as a rule, however, it disappears either spontaneously or under proper treatment, of which flushing of the urinary tract with abundant water forms the most important feature.

A condition morphologically similar to this sometimes occurs in senile subjects or in such diseases as are accompanied by extensive destruction of bone. Here, however, the deposit is made up of calcium phosphate and carbonate, which is found deposited chiefly in streaks outlining the medullary tubules.

As a rule, the calculi of larger size that are found in the renal cortex or in the medulla have been formed as the result of the agglutination of smaller particles about a nucleus that is not rarely of quite a different nature from that of the succeeding laminæ. The small nucleus probably acts as a foreign body, causing the formation, about it, of an inflammatory exudate composed of blood or albuminous fluid, resulting in the precipitation of a submorphous material that agglutinates and forms the calculus, which occasionally takes on the greatly exaggerated form of a urinary tubule or glomerulus. Generally, the uric-acid calculi formed in this manner are very hard, smooth, and dark brown or red in color; those made up of calcium oxalate are rough, covered with sharp spicules or nodules, and are white in color, although stained more or less with blood-pigments. The larger phosphatic calculi are rarely found in this portion of the kidney, but usually lodge in the pelvis, although oftentimes their nuclei, probably formed in the cortex or medulla, consist of urates or oxalates.

Pelvic calculi may be of large or small size, or, as previously stated, may take the form of a sand-like deposit. When they are retained in the pelvis for any considerable length of time they

tend to increase rapidly in size, this being largely due, probably, to the secretion of mucus excited by their presence in this portion of the urinary tract. They are extremely likely to set up suppuration, and when alkaline fermentation is added to the existing elements that predispose toward calculus formation, the stone will increase rapidly in size, so that the entire pelvis may be found to be occupied by a laminated calculus that forms a perfect mold of the cavity.

If the calculi are small, they will very possibly be passed through the urinary tract without the patient's knowledge, or slight pain, hematuria, and the like may accompany their exit; at other times they may become encysted in the renal tissue. In the male they frequently pass into the bladder, being retained there; in the female, owing to the different anatomic conditions, they are more commonly passed; this probably explains the greater frequency with which cystic calculi occur in men. Not rarely the calculus, in its passage through the ureter, may become lodged there, causing obstruction of that canal. If this takes place, it necessarily interferes, to more or less of a degree, with the urinary outflow. The immediate results of this obstruction, beyond the disturbance caused by pain, may not be serious. The late after-results, if the obstruction by the calculus is confined to one ureter, will be hydronephrosis or renal atrophy on the affected side. Beyond a certain amount of pain, but little disturbance may result. If, however, calculi become lodged in both ureters, death will follow unless prompt operative measures be taken.

Symptoms.—Renal calculus may be present without giving rise to any symptoms. Stones of considerable size are not infrequently found at autopsy, embedded in the kidney substance or inclosed in the pelvis, that gave no manifestations of their presence during life. In typical cases the patient complains of pains in the renal region, commonly radiating downward toward the bladder or groin and into the testicle; occasionally they are referred to the opposite side. These pains, accompanied by a sensation of weight, are exaggerated on violent exercise.

As a rule, crystals or renal sand are found in the urine with more or less regularity; leukocytes and red blood-cells are also commonly present, particularly following active exercise. Pus may also be

present when, as is generally the case, infection has taken place. When obstruction of the ureter occurs from time to time, the urine is excreted in small amounts until the calculus is displaced, when there is a sudden gush of urine, which is usually clouded with leukocytes, and most probably with sand and desquamated pelvic or ureteral epithelium, and with large quantities of mucus.

Paroxysmal pain occasionally manifests itself, even when the stone is too large to engage in the ureter; this pain is sometimes so severe as closely to simulate the renal colic that develops when stones enter the ureters and pass downward toward the bladder. Renal colic is particularly prone to develop after exercise or from any cause that tends to displace the stone. It is ushered in with extremely severe, cramp-like pains, generally in the renal region of the affected side, and radiating from this point outward, principally downward along the urinary tract; it is often localized at the head of the penis or in the testicles. Severe chill, nausea and vomiting, and sometimes violent diarrhea may appear; the pulse becomes weak and rapid, and the skin bathed in a cold perspiration. These symptoms abate only when the stone has passed into the bladder or when the contractions of the ureter have ceased. One occasionally sees cases at autopsy in which the calculus has paused in its transit, obstructing the ureter, and becoming encysted in this region. When the stone has been passed, there is usually a gush of blood-stained urine, which is turbid with cells from the urethral mucosa and with mucus and leukocytes.

Although the characteristics of renal colic are quite marked, the condition may occasionally be mistaken for gall-stone colic; the diagnosis can be verified only by an examination of the urine following the attack. The calculus may be discovered by means of the cystoscope or sound in the bladder, or when the stone is forced out through the urethra, the patient, if a male, generally becomes aware of the fact.

Diagnosis.—As previously indicated, the diagnosis of the condition is based on the pain, the examination of the urine, the cystoscopic findings, and the determination of existing obstruction in the ureters. Harrison believes it possible to detect the presence of a renal calculus by a peculiar grating sensation that

is conveyed to the hand when the kidney is palpated. The writers have never been able to verify this.

The *x*-ray now affords a means by which the larger renal calculi may easily be located. The character of the stone, however, has much to do with its clear definition by the rays, and the result depends largely upon the experience and skill of the photographer. Some photographers, particularly in the larger cities, are becoming so skilful in this line of work that they seldom fail in their efforts if the stone is of any considerable size.

The ureter catheter or bougie, having its tip coated with wax, is of great diagnostic aid in renal calculus. A stone in the ureter or pelvis of the kidney will betray its presence by the feel and by the scratches it makes upon the wax.

As mentioned in a previous chapter, massage over the region of the suspected kidney and ureter, for the purpose of forcing their contents into the bladder, followed by immediate examination of the urine, may aid in making a diagnosis, particularly if, after such massage, the urine is bloody.

Treatment.—The treatment divides itself naturally into three parts: (1) The prophylactic treatment; (2) treatment of stones lodged in the renal tissue or pelvis; (3) the treatment of renal colic.

When a predisposition to the formation of calculi is known to exist, or when the urine is frequently clouded with uric-acid crystals or with calcium oxalate, the patient should be directed to drink large quantities of water; for this purpose distilled water or any of the alkaline waters may be used with benefit, the good results being probably due more to the quantity of fluid passed than to the character of the water taken; by the use of the alkaline waters, however, as in the special instances just mentioned, the chemic nature of the urine may become so altered as to hold in solution certain crystalline bodies that might otherwise become precipitated into the substance of the kidney. Good effects have been reported from the use of large doses of glycerin given by stomach. Those acid fruits and vegetables that are known to increase the presence of calcium oxalate crystals in the urine should be avoided, and, in the case of uric-acid crystals, such

dietetic rules should be observed as will minimize the danger of an excessive output. In certain cases good results are obtained from the use of lithia or sodium or potassium bicarbonate in full doses. On the whole, however, the most important feature of the treatment is the drinking of increased quantities of water. Once a calculus of considerable size has formed in the renal tissue or in the pelvis of the kidney, it is very doubtful whether any of these measures are of benefit, although certain waters are said to possess remarkable curative powers in this direction. When alkaline fermentation, associated with infection, has taken place, urinary disinfectants, such as salol, urotropin, and the salicylates, have been used with benefit.

The first step in the treatment of renal colic consists in relieving the intolerable pain. As a rule, hypodermatic injections of morphin will be required, or, when these fail to give sufficient relief, chloroform inhalations may be demanded. Hot sitz-baths, hot poultices to the renal region, and the drinking of hot water are all useful measures. In several instances the writers have employed atropin hypodermatically with excellent results, both as regards relief from pain and as a means of preventing the muscular spasm which is apparently largely responsible for the pain. At the same time this relief seems to facilitate, at least in some cases, the passage of the stone. When the acute attack begins to subside, lithia citrate or sodium bicarbonate, with abundant quantities of water, associated with a diet tending to reduce the urinary solids, and particularly those elements that make up the stone, is to be recommended. After these attacks, the stone should always be sought for in the urine or, if necessary, in the bladder, for a knowledge of its nature serves as an excellent guide to the most appropriate subsequent treatment, both dietetic and medicinal.

As to the best method of effecting removal of a calculus, each case is, in a way, a law unto itself. Fortunately, nephrotomy for the removal of stone is not usually a very serious operation; much, of course, depends upon the condition of the patient and upon the size and location of the stone. Edebohls' incision, which will be described further on, is the one ordinarily to be recommended. After the kidney has been exposed, the stone should be searched for by means of needles run through the kidney in various direc-

tions. Once found, it is generally comparatively easily removed with forceps through an incision, followed by packing the wound if hemorrhage is severe. If the opportunity presents itself during the operation, the permeability of the ureter may be ascertained at this time, or this may subsequently be learned by ureteral catheterization. A further and more complete consideration of the surgical treatment for renal calculi will be found later in the chapter dealing with the surgery of the kidney.

CHAPTER XV

TUMORS OF THE KIDNEY

Renal tumors are relatively rare; this is particularly true of those neoplasms that affect the kidney primarily, and it is with these primary growths that we are chiefly concerned, for secondary renal growths are seldom of much clinical importance, and usually occur but as a local manifestation of a fatal generalized disease; but little is, therefore, gained by their treatment.

The new-growths of the kidney are best divided into three classes—granulomatous, parasitic, and neoplastic. The first includes isolated tubercles, gumma, and actinomycotic foci. As regards the relative occurrence of tumors of the kidney Kélynack, in an analysis of 306 primary renal growths, found 115 sarcomata, 22 myosarcomata, 145 carcinomata, 15 fibromata or lipomata, and 12 adenomata. In this series the author failed to consider the hypernephroma, which probably formed a considerable proportion of the tumors listed as sarcoma or carcinoma.

Tuberculosis and gumma of the kidney are more appropriately discussed elsewhere under special heads. Actinomycosis is very rare, and has never, in so far as we have been able to learn, been found primarily in the kidney.

Parasitic tumors are seen, due to the action of the echinococcus and to the Cysticercus cellulosæ. Hydatid cysts of the kidney are not particularly uncommon where hydatid disease is frequent, but it has been but rarely reported in this country, and we have seen but a single case. The cysts present nothing of special note, and may be either large or small. The condition is commonly found associated with other cysts elsewhere. The Cysticercus cellulosæ is exceedingly rare, and in so far as we can learn, has never been observed in America.

The true neoplasms of the kidney are most conveniently classed as innocent and malignant. The benign tumors of the kidney are of relatively little importance, and there is surprisingly little general or local disturbance following their development in the

renal tissue. Named in their relative order of occurrence, the chief innocent tumors of the kidney are fibroma, lipoma, myomata, and angioma. **Fibromata** occur most commonly in the cortical portions of the organ, less frequently in the capsule. They are usually round, and appear as small, rarely large masses of connective-tissue fibrils arranged usually in whorl-like bodies. In some cases they appear to have originated about tiny blood-vessels,

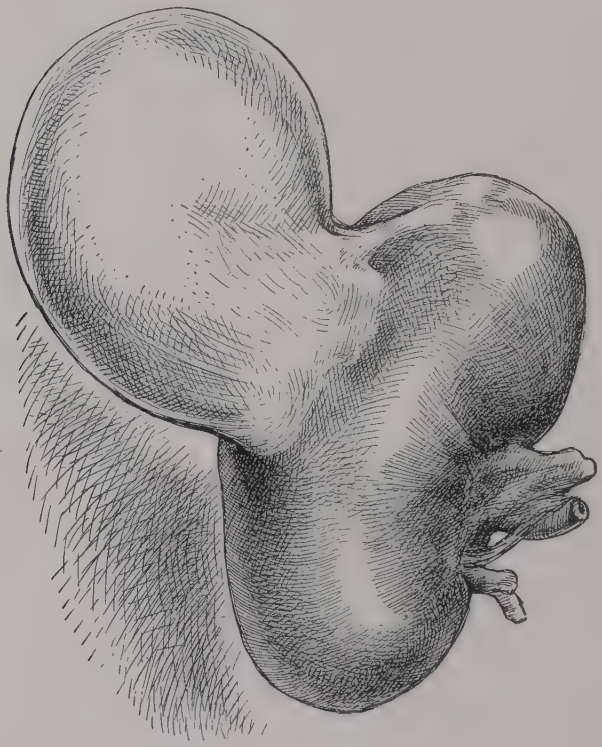


Fig. 93.—Lipoma of kidney (authors' case).

perhaps as a result of inflammatory hyperplasia, but in other instances they are unquestionably truly neoplastic. As a rule, they are not well differentiated from the stroma of the organ. **Lipomata** are growths from the capsule in practically all instances. They may, as illustrated in fig. 93, be of considerable size, and though well differentiated from the renal tissue, they

may cause considerable pressure atrophy or erosion of the renal tissue, as was the case with the lipoma illustrated. **Myomata** are of two classes—leiomyoma and rhabdomyoma. The former growth is commonly found in the capsule and is of small size. Occasional isolated smooth muscle-cells may be found in some fibromata. **Rhabdomyomata,** or striped muscle tumors, are most frequently found in infants, and they are associated in most cases with sarcomatous or teratomatous neoplasms. They are often of large size, and infiltrate the renal tissue diffusely, so as to make enucleation impossible without total nephrectomy. Manifestly, they are usually more or less malignant, and in most of such cases they grow rapidly and set up fairly early metastases. As growths which also possess a semi-malignant nature at times are the adenoma and papilloma. **Adenomata** are reported by the older authors as relatively frequent, but as we grow more familiar with the hypernephromata, most of us are inclined to place among these many or most of the tumors previously considered as adenomata. Thus two cases of adenomata of the kidney reported by one of us have been subsequently classified as hypernephromata. True adenomata of the kidney are probably rare. They occur as well-encapsulated masses of tissue, made up of tubular-like arrangements of epithelial cells, which resemble but do not fuse with the tubes of the renal parenchyma. Adenomata are chiefly reported as occurring in the cortex. **Papillomata** of the kidney are seen almost exclusively in the pelvis. They are of considerable importance, since relatively frequent and because calculi are apt to form about them. They also probably eventually become malignant in a considerable percentage of cases. **Angiomata** are usually found in the cortex of the kidney and are commonly of small size. They are most likely to be found in conjunction with hemangiomata in other organs, notably in the liver, heart, or skin. They are probably mostly congenital in origin, but may follow inflammation or the necrosis subsequent to embolic infarction.

According to Kélynack, of all malignant tumors, those occurring primarily in the kidney form but 3 per cent. of the total, but Virchow reports, however, that 5 per cent. so occur.

A point of considerable interest is the fact that, of malignant

growths of the kidney, by far the larger percentage, even of the carcinomata, are stated to occur in children, usually under fifteen years of age. The writers' experience has been chiefly limited to adults, which may account for the fact that renal new-growths have been found so rarely by them. Thus in 656 consecutive complete postmortem examinations, 40 cases of malignant tumor were found, but three—one sarcoma and two hypernephromata—of which occurred primarily in the kidney.

Carcinoma.—Carcinomata of the kidney are, as a rule, of the tubular variety. They are often of the so-called roseate form, and to the unaided eye appear to have a firm, dense, white center, from which branches radiate like the spokes of a wheel. They are frequently seen to be distinctly encapsulated, although microscopically the tumor-cells are commonly found to have penetrated this enveloping membrane. There can be no question but that some cases reported as renal carcinomata are in reality hypernephromata. Two instances originally reported by one of the writers as primary carcinomata have been, in the light of more recent research, properly included under the hypernephromata. It is doubtless true, as has often been claimed, that renal calculi, and particularly pelvic stone, play a part in the production of carcinoma, generally of the epitheliomatous variety. Pelvic epitheliomata, which are relatively frequent, originate from the mucosa of the pelvis, and also arise from papillomata; indeed, this possibility is, in the writers' opinion, one of the principal reasons why operative procedure is so strongly indicated in these cases of pelvic papillomata.

Sarcomata of the kidney are commonly seen in childhood, and are generally of congenital origin; they may be found well developed at birth. As is naturally to be expected, these congenital sarcomata assume many of the characteristics of the teratomata. Thus a considerable number of them are myosarcomata, often of the class of rhabdomyosarcomata, and they contain elements characterizing them as congenital neoplasms, and indicating that they originate as the result of improper fetal development of the intermediate cell-mass. So far as the writers' experience with this class of tumors goes, epithelial elements in the tumor are wanting; but Larkin has recently shown such a tumor primary in or about the

kidney, and in which distinct gland-like acini and other unmistakable epithelial structures were present.[1]

As a rule, in sarcomata, both in the congenital and in the adult variety as well, the general contour of the kidney is preserved, although it is somewhat nodular. In the early stages, however, the growths may be discrete and even encysted. Both kidneys are involved in a surprisingly large number of cases. Cystic sarcomata are relatively frequent, and in most cases they are also of congenital origin. Round-cell, spindle-cell, and mixed-cell sarcomata are also found to some extent, and angiosarcomata and peritheliomata are likewise known to occur. In some cases of **lymphosarcoma,** or Hodgkin's disease, secondary tumor-masses histologically like those of true sarcoma appear in the kidney. In a recent case of one of the writers the lymphomatous masses were so sharply differentiated from the renal tissue in color and gross structure that they appeared to be distinct and well-defined neoplasms. As with other secondary tumors of the kidney, these growths are of little or no clinical importance. **Endotheliomata** occur only as metastases.

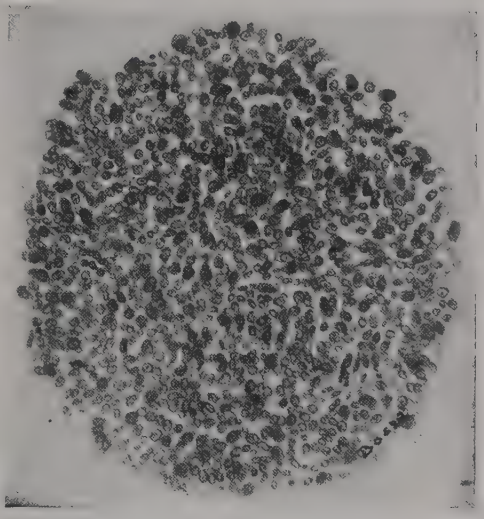


Fig. 94.—Microscopic structure of a hypernephroma. Authors' case (see text). Note varieties in size and shape of cells.

There can be no question but that the most frequent tumor that occurs as a primary growth in the kidney is that known as the **hypernephroma,** or the "struma lipomatodes aberratæ renis" of Grawitz. A careful study of the tumors included in the series of Kélynack, and even the descriptions of renal cancer, adenoma, sarcoma, endothelioma, and the like, cannot but convince

[1] "Transactions New York Pathological Society," March, 1908.

one that many of these tumors really belong to this large but ill-defined class of new-growths. The hypernephromata are said to spring from bits of fetal tissue originally intended to develop into adrenal bodies, but which become detached and incorporated in the anlage for the kidney. In the larger number of cases, undoubtedly, they remain as harmless bodies in the kidney tissue, and are often discovered postmortem in the form of round or oval masses of pinkish or grayish tissue generally found in the cortical portions of the organs, and usually well differentiated from the remainder of the renal substance. Microscopic examination of these bodies shows them to be made up of columns, sometimes alveoli of large cells, rich in protoplasm, in which coarse oil-globules appear. Pigment granules are often seen. The close resemblance these cells bear to those of the adrenal body, particularly to the cells of the zona glomerulosa, is often striking. It has long been customary to describe such small growths as adenomata.

Under certain conditions, which are no better understood than are the causes of other neoplastic growths, these islands of aberrant tissue begin to proliferate. At times the increase in size is so rapid as to be easily discerned by a weekly palpation of the abdomen. As an exception to this customary rapid progress may be mentioned a case, recently reported by Richard Weil, in which the growth extended over a period of fourteen years before general or fatal metastases resulted. The writers have seen five cases of this growth postmortem, and each has differed markedly, both in clinical and in anatomic aspects, from the others. Only in the histologic character of the new-growth could similarity be traced.

Metastases are apparently transmitted both by the lymph-channels and by the blood-vessels. Those the result of direct extension have not been frequently seen in the writers' experience. As has been stated elsewhere, the malignancy of these tumors and the rapidity with which metastases are formed render prognosis in these cases particularly difficult. Great diversity exists in the distribution of the metastases. Three of the five cases seen postmortem by the writers showed early cerebral metastases, whereas in one of the remaining two the first discoverable secondary growth appeared in the corpora cavernosa, the venous erectile

Hypernephroma of kidney. Authors' case. (Specimen in Museum of Carnegie Laboratory.) *a*, Tumor, partly encapsulated; *b*, solid portions of growth; *c*, necrotic portions of growth. (Natural size.)

spaces of which became, within a few weeks, literally packed with tumor-cells.

Frequently the primary growth in the kidney remains small, although the general infection may be rapid. On the other hand, the tumor may become of enormous size, and the general infection be either slight or entirely absent.

As is to be expected from their origin, the growths may occur either in youth or in adult life.

It is because of the great variety of the histologic pictures presented that these growths have frequently been reported as adenomata, carcinomata, sarcomata, and epitheliomata. It is indeed difficult to draw a picture typical of a structure whose chief characteristic is its variability, for in certain cases the growth closely resembles carcinoma; in others it simulates sarcoma; and occasionally cells resembling syncytial cells are seen. Only by a study of the structure of all the lesions presented, and largely by excluding other growths, can the postmortem diagnosis be made in those cases in which rapid growth and general infection have taken place. When the tumors are small and localized in the kidney or liver, the diagnosis is made easier from the close resemblance they bear to the normal adrenal structure.

DIAGNOSIS

As has previously been intimated, in a considerable number of renal tumors, particularly when they are of small size, of slow growth, or are situated in the capsule or the cortex, diagnosis is impossible. As a rule, an early diagnosis of pelvic growths may be made from the appearance of blood in the urine, which is an almost constant symptom; and, in the case of papillomata, from the presence, in the urine, of bits of the new-growth. The chief feature in the diagnosis obviously is the presence of the tumor, and this cannot, of course, be demonstrated until the growth has reached a palpable size. Its renal origin may be distinguished by the usually immovable fixation of the growth, its relationship to the kidney region, and fairly often by its reniform shape. The fact that it lies posterior to the intestine can usually be elicited, if necessary, by the inflation of the gut with air, and in some cases a more pronounced bulging posteriorly than anteriorly serves as

an important diagnostic point. The firm and compact nature of the tumor also helps to distinguish it from cystic kidney. Even in those cases in which the tumors do not impinge directly on the pelvis, hematuria is generally present. As a rule, it occurs periodically, although when the growth is of considerable size, or when it reaches the pelvis, hematuria may be a constant manifestation. In those cases in which satisfactory palpation is not possible, cystoscopy and catheterization of the ureters may determine which is the diseased side.

As a rule, there are no marked symptoms. Pain in the renal region, with a feeling of weight, may be complained of. This pressure may cause more or less venous congestion of the superficial abdominal or of the spermatic plexus of veins; or perhaps edema of the lower extremities may develop.

Radiography is often a most satisfactory means of making a diagnosis, and occasionally a carefully prepared plate shows a fairly clearly outlined shadow, and may indicate the extent and location of the growth very satisfactorily even in obese subjects.

When metastases have developed, their distribution and connection with the direct vascular system or the lymphatic groups of the kidney may be of some assistance, although, as stated elsewhere, the most frequent renal tumor, the hypernephroma, is very erratic in its selection of points for metastases. In some rare instances the distribution and nature of these secondary growths may even make clear the precise type of the tumor; and when nodules are superficially located, as, for example, in the inguinal lymph-nodes, removal of small bits of tissue for the purpose of determining its character is certainly justifiable. In considering these renal growths, gumma of the kidney should always be thought of as a possibility, although it occurs but very rarely. Exploratory operation and direct palpation of the kidneys are often demanded, and, considering the comparative safety of these surgical measures, it is the writers' belief that recourse should be more frequently had to this means of formulating an absolute diagnosis.

Cachexia may or may not be present, and its absence, as well as the absence of the anemia usually accompanying new-growths,

is not to be considered as a contraindication that malignancy exists, since the sarcomata and hypernephromata often show the gravest manifestations before severe cachexia or anemia develops.

The precise variety of the growth can often be determined only by a microscopic examination of bits of the affected tissue or by inspection of the involved organs; yet, as a rule, we are justified in diagnosing those tumors that occur in early life as either sarcomata or hypernephromata, whereas those that appear later in life are either carcinomata or hypernephromata.

GENERAL CONSIDERATIONS OF TUMORS OF THE URINARY SYSTEM AND THEIR TREATMENT

Since the last edition of this work many new methods for the study of malignant growths have been evolved, and it has seemed necessary to us, even at the risk of being criticized for overstepping the natural boundaries of our work, to consider this subject as it affects the body as a whole, for in that way only can we present our views as to their treatment in the special organs considered in this work.

Among the most notable studies bearing on the biology of new growths are those on the inheritance of rat and mice tumors by Dr. Louis Loeb, of St. Louis, and those of Miss Maud Slye of the Ortho-Sprague Institute of Chicago. Their results should certainly stimulate surgeons called upon to deal with malignant growths to take, as a routine, the most painstaking and careful history of individuals suffering from neoplasms when they come under their care. The influence of the Mendelian law in tumor formation seems to have a very direct and pertinent bearing on the study of all new growths.

Among the new methods of treatment which seem to promise real benefit, two have, within the last few years, been extensively tried out. These are treatment by the *x*-ray and that with radium. Growths in the urinary tract treated by the *x*-ray are, however, few, and none have come under our personal observation, but it is probable that a field is opening for these methods in the treatment of growths of the bladder and kidney.

We believe that radium treatment has come to stay, either

used directly for the removal of malignant growths, or as a valuable after-treatment following operation. When there are no metastases and the radium is properly applied, either with or without other operative procedures, we believe it capable of curing cancer in some few instances. Legueu (Journal d'Urologie, 1914) reports a case of inoperable carcinoma of the urethra and vagina in a young woman treated by two applications of radium, the second one applied several months after the first on account of recurrence of the growth, so strongly as to give rise to a desquamation. The woman died from another disease two years after the last application, and a most painstaking and thorough autopsy failed to reveal any evidence of carcinoma anywhere in the system. Two associates and a friend some two years ago applied the same quantity of radium for the same length of time following suprapubic cystotomies for malignant growth of the bladder. One of the individuals on whom the application was made died very shortly, the second died in five months of metastasis of the kidney, the third is apparently entirely well, and has gained some 30 pounds in weight. These cases are mentioned as illustrating our views concerning what can be expected in the use of radium.

Concerning the application of radium in bladder tumors under ordinary circumstances we are inclined to believe the most practical method is to open the bladder and apply the emanations directly to the growth, or to the seat of the growth after it has been removed.

Internal Treatment.—Malignant growths of all locations are so dependent on general conditions that it seems they may be beneficially influenced and life prolonged by the persistent and constant carrying out of every logical procedure, hygienic or medicinal. Tonics, particularly those which seem to increase oxidation, such as manganese and iron in as large doses as can well be borne, arsenious acid in some form, and the prolonged ingestion of various bitters, inunctions of such as echinacea, are probably of some benefit. Apparently the selenium salts have some effect in diminishing pain, and perhaps tend to make malignant tissue break down. Probably of more value is the administration of $\frac{1}{30}$ grain three times daily of the sulphocyanid of selenium in an alkaline media; it can safely be given internally for four or five days with equal

intermissions between. A curious fact to be noted here is that, acting on the suggestion of Dr. H. W. Fetzer, the examination of a large number of samples of urine from our cancer patients by the chemist, John Killian, has shown they all contain *a large increase in the amount of neutral sulphur*. While the persistent use of such general treatments is advocated by us and is recognizably only empiric, in our observation general measures are too often neglected in the treatment of new growths by all physicians.

CHAPTER XVI

THE SURGERY OF THE KIDNEY

The examination of the kidney for diagnostic purposes has been discussed in previous chapters. To repeat, percussion and ballottement over the kidney area may give useful information. Bimanually, the kidney region should be examined by having the patient lie on his back on a table, with the legs drawn up, one hand of the surgeon being placed under the back in the space be-

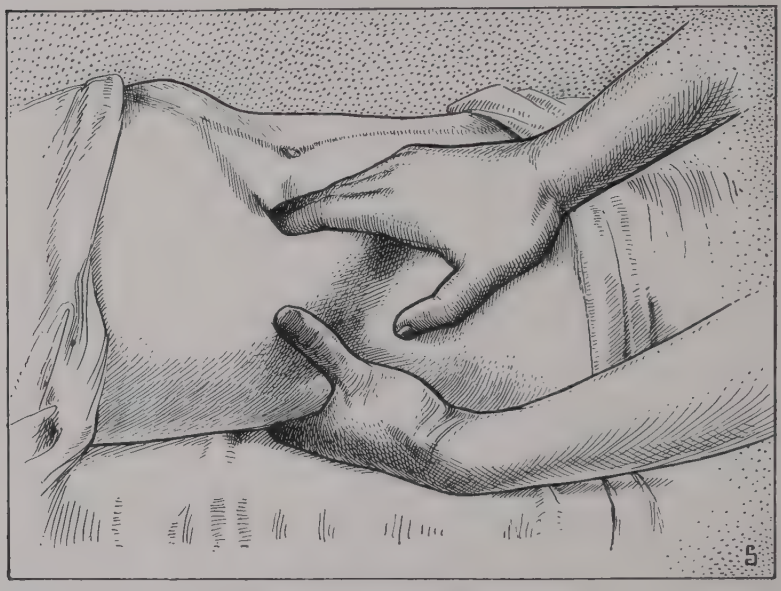


Fig. 95.—Bimanual examination of the kidney.

tween the border of the last rib and the crest of the ilium, the other hand occupying the corresponding space over the abdomen in front. The kidney may thus be examined between the two hands, the surgeon increasing pressure as the patient exhales, the abdominal muscle being contracted as little as possible. Another similar procedure is that of having the patient lie over a table or chair, the kidney being felt for bimanually, in the manner previously directed. It has been stated that in cases of pelvic tumors

if the pelvis is elevated, the tumor tends to fall toward the source of its origin, and that by this method a differential diagnosis may be made between a tumor of the kidney and one of some other organ. The writers have not found this procedure of any value. It has been their experience that, for the physical examination of the kidney bimanually, that method with which the surgeon is most familiar will yield the most information; that the ease with which information can be acquired by physical examination

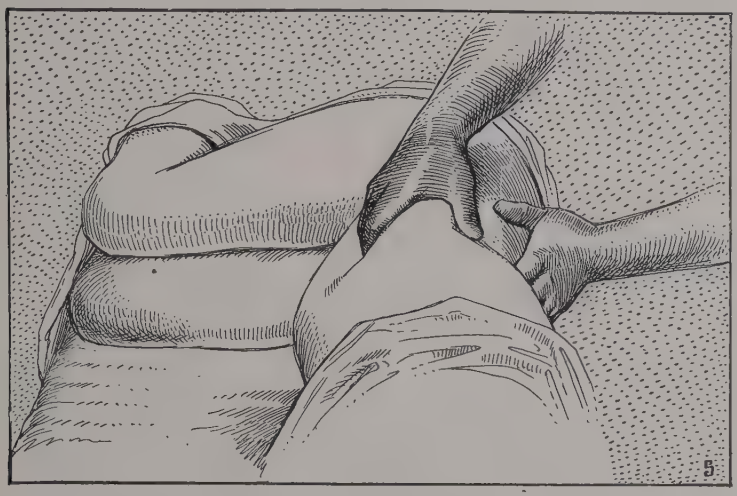


Fig. 96.—Examination of kidney with patient lying on side.

is very much increased by practice. Now that a keener interest has been awakened in determining the physical condition of the kidneys, it is to be hoped that the general practitioner will examine the kidneys bimanually as a matter of routine more frequently than was done in the past. Kidney dissections and operations on the cadaver are of particular value in familiarizing one with the situation and surroundings of these organs. In spite of the various aids to diagnosis previously mentioned, some surgical conditions will remain in doubt until the question be solved by an exploratory operation. This is particularly true of tumors of the kidney, and more especially of those tumors that are either on or connected with the organ, and yet interfere so little with the kidney function that information cannot be obtained by means of urinary examination or ureteral catheterization. This is not infrequently the case when there is a question of stone or of tuberculosis.

The method of massage of the kidney region, as given in detail in the article on "Suppurative Nephritis" earlier in the volume, will be found to be a most useful and practical procedure for determining whether a pus kidney may or may not be present.

In this chapter the following operations will be considered: (1) The operation for the exploration of the kidney. (2) Nephropexy, the operation of anchoring a displaced kidney. (3) Nephrotomy, the operation of opening the kidney for abscesses, stone, and similar conditions. (4) Nephrectomy, the operation of removing the kidney, either in whole or in part. (5) The operation for performing decapsulation of the kidney. (6) Operations for

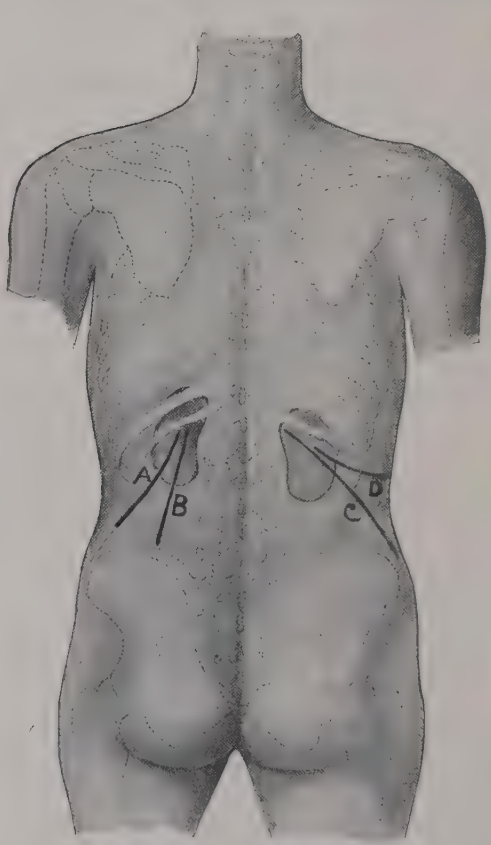


Fig. 97.—A, Loin incision; B, Edebohls' incision; C, Israel's incision; D, transverse incision.

Fig. 98.—Showing continuation of Israel's incision.

the treatment of Bright's disease. (7) The operation for performing lavage of the pelvis of the kidney.

OPERATIONS FOR THE EXPLORATION OF THE KIDNEY

The incision through the loin is the one that is ordinarily recommended for exploring the kidney. The following is the description of the operation as laid down in the standard text-books, with supplementary remarks as to such special details as have proved most satisfactory in the hands of the writers.

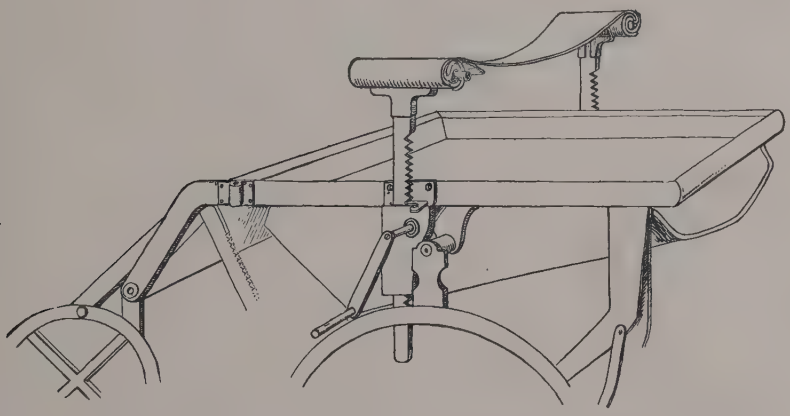


Fig. 99.—Illustrating the "Mayo" attachment to surgical table for operations on the kidney.

Before making the incision in the loin, the patient is placed upon the side opposite the one that is to be incised. The flank to be operated upon is elevated by sand-bags or, better, by placing an Edebohls bag under the opposite side. The guiding points are the twelfth rib, the crest of the ilium, and the external border of the erector spinæ muscle. The incision should be begun about half an inch below the twelfth rib, close to the border of the erector spinæ, and descend obliquely downward and forward until it is about a finger's breadth from the crest of the ilium. (This incision is shown in the illustration, fig. 101.) After dividing the skin, the superficial fascia, fat, and the latissimus dorsi, the internal border of the external oblique muscle is exposed. Being incised, the internal oblique and the posterior aponeurosis of the transverse muscle are

Fig. 100.—Edebohls' pad for operations on kidney.

laid bare. Cutting through the aponeurosis, the yellow fat of the perirenal tissues appears in the fatty capsule. This fat is much more evident on the posterior than on the anterior surface of the kidney. At times it resembles the peritoneum.

The fatty capsule being reached, it should be carefully opened on the directer for an inch or more, the finger inserted, which should gradually break down the adhesions which exist between the fatty capsule and the true capsule of the kidney. Ordinarily but little difficulty is experienced, which is apt to be most marked at the poles. When both poles of the kidney are freed from the fatty capsule, the freeing of the remainder of the kidney is a com-

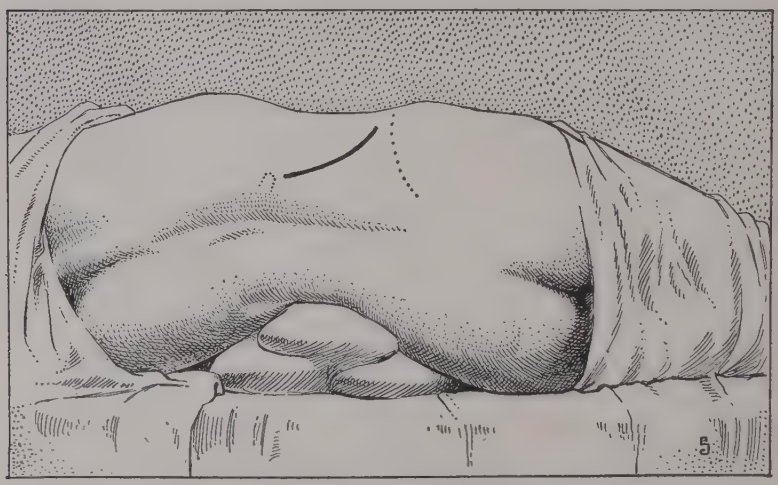


Fig. 101.—Ordinary exploratory loin incision for exposing the kidney.

paratively easy matter. The kidney, having been freed from the fatty capsule, can, provided it is not too large, be lifted up into the wound and its general appearance observed. Particularly is it necessary to carefully palpate the pelvis of the kidney and ascertain as much as possible concerning its condition. Naturally, should the operator prefer, the kidney may be reached through the Ebebohl's incision or through a laparotomy incision. It should be borne in mind that kidneys not infrequently normally vary somewhat in shape and size. The shape of a kidney being slightly different from the usual may not necessarily mean that the kidney is diseased. The operator not being content with the

manual examination of the kidney, in order to ascertain fully the condition of its interior, should next decide the incision to use in the particular case. It is a comparatively easy matter, a compression being made on the pedicle of the kidney by an

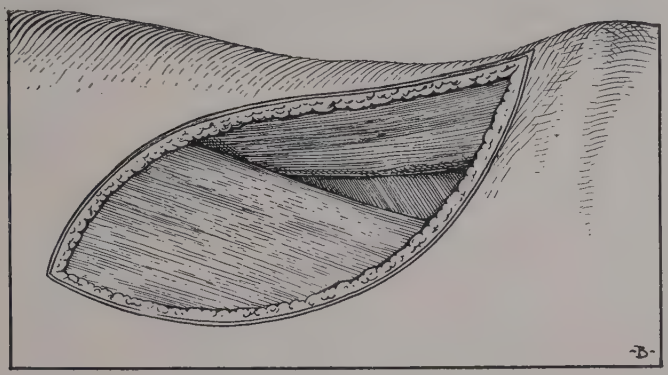


Fig. 102.—Illustrating loin incision for exploration of the kidney. Appearance after incision of skin and fatty cellular tissue.

assistant, to control the hemorrhage from the kidney, or a pedicle clamp may be used protected by a rubber cover. The procedure of puncturing the kidney with needles, often used in the past, is gradually going out of use, and exploratory incisions into the

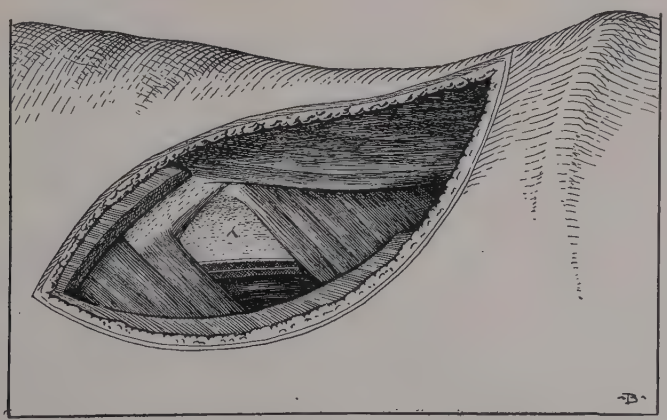


Fig. 103.—After section of latissimus dorsi. Cross showing position of incision of the aponeurosis of the transverse muscle.

kidney tissue are coming more and more into vogue. If a stone can be felt or an abscess or tumor is causing any bulging of the tissue, the place of incision of the kidney will be indicated by the

prominence. No particular spot being indicated, it is necessary to explore the kidney. It is particularly advisable when making an incision into the kidney to make one that will either directly or indirectly lead to the pelvis of the kidney, and for that purpose the incision recommended by Albarran, a picture of which is given (fig. 108), will be found the most useful. This incision, to commence with, is about three-quarters of an inch deep and leads toward the lower calix of the kidney. By means of dilatation with the scissors the opening should be enlarged so as to permit the finger to penetrate, then, without tearing apart the renal tissue, through it the finger can gradually make its way into the pelvis of the kidney. If this incision should not be feasible, the so-called "postmortem" incision, of which an illustration is given (fig. 109), may be employed. After the kidney has been explored the incision should be sutured with No. 2 catgut. If pus has been found in the exploration, a small drainage-tube should be inserted well down in the pelvis of the kidney, and the wound sewed up around the tube. If any decapsulation has been performed during the operation, care should be taken that part of the true capsule be left around the incision to help hold the stitches.

It is being suggested of late, in certain conditions where the kidneys are being explored, that it is well to resect a portion of any tumor, or of the parenchyma of the kidney in certain cases, and have a quick microscopic examination made which should give aid in the diagnosis. Such procedures, unfortunately, are at present to some extent more of a theoretic than they are of practical value. The reason is that while the hasty examination in certain cases may be of benefit, in such conditions as tumors of mixed form, quite a prolonged examination will be necessary in order to determine the nature of the growth.

NEPHROPEXY

In performing the operation for fixation of movable or floating kidney the patient should be placed on the abdomen over a sandbag or an Edebohls pad. Make an incision that starts about two and one-half inches from the spine, extending from the lower border of the twelfth rib to the crest of the ilium, and nearly parallel with the spine. The inventor of this incision suggests

that if this does not give room enough, the outer margin of the quadratus lumborum be nicked, very near its insertion into the crest of the ilium. An incision is made through the muscles until the perirenal fat is reached, and carried through this until the capsule of the kidney is exposed; the patient's feet are then seized and the body drawn toward the foot of the table. The Edebohls pad, well inflated, is thus brought under the margin of the lower ribs, and tends, in most cases, to press the organ up through the incision and thus aid in exposing its posterior aspect.

It is difficult to advise as to the best method of anchoring the kidney. The various operators all have different views on the

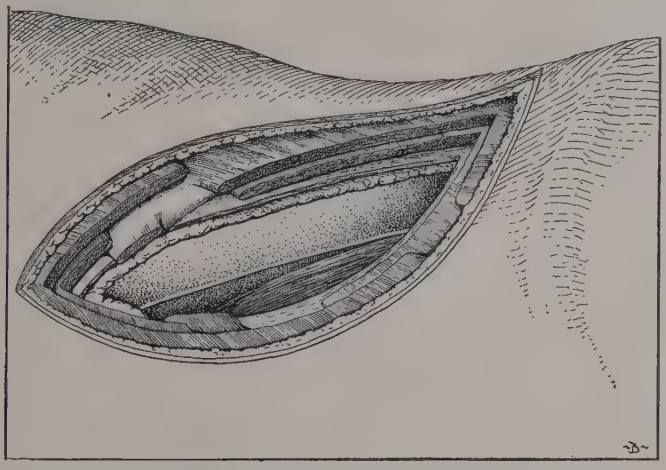


Fig. 104.—The aponeurosis of the transverse muscle having been incised.

subject, and to make the matter still more confusing, from time to time these views are modified and different methods suggested from those previously practised. Generally speaking, the operation of anchoring the kidney in its proper position used at present consists in one of two methods—that in which the sutures are placed through the true kidney tissue, and that in which they are placed through the true capsule of the kidney. There are various modifications of these methods, based on whether the capsule should be removed entire or in part. The evidence is very convincing as to the permanent retention of the kidney in this position after fixation by the method advised by Dr. George M. Edebohls and described by him in an article entitled "The Technics of

Nephropexy as an Operation *per se* and as Modified by Combination with Lumbar Appendicectomy and Lumbar Exploration

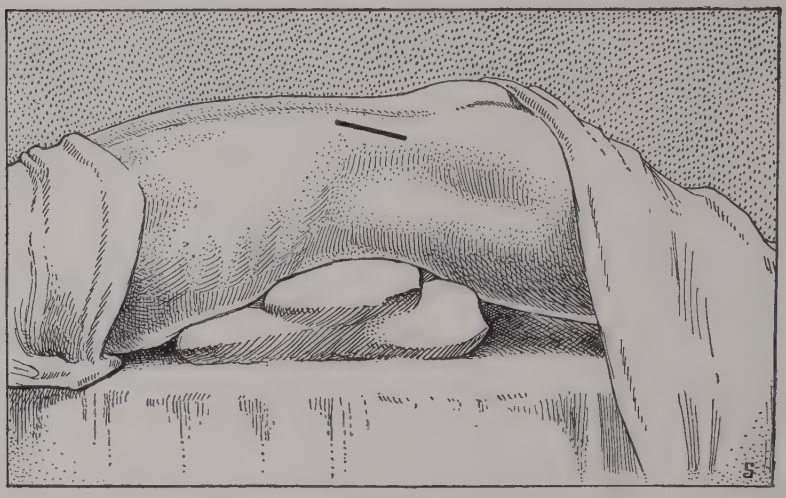


Fig. 105.—Edebohls' incision for exposing the kidney.

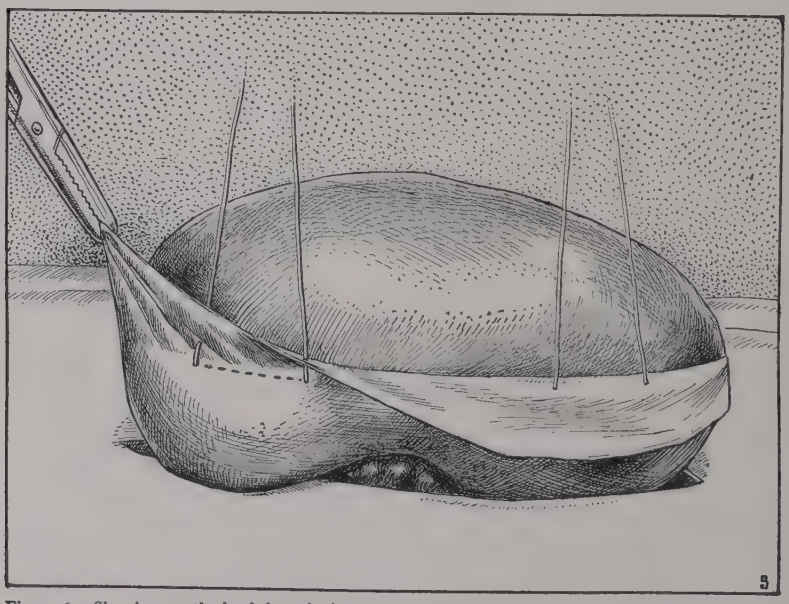


Fig. 106.—Showing method of introducing sutures into exposed kidney, capsule having been rolled back (Edebohls).

of the Bile-passages," "Annals of Surgery," February, 1902. His method is practically as follows:

The kidney having been exposed through the incision previously mentioned, and freed, so far as necessary, by blunt dissection, is delivered through the wound on to the back. The fatty capsule is dissected off so as to expose the capsule proper through its entire extent, and the kidney palpated. The iliohypogastric nerve is drawn to one side out of reach of injury. If this cannot be done, and the nerve must be divided, reunite the severed ends with catgut after anchoring the kidney and before closing the wound. Then a nick is made in the capsule proper near the middle of its convex border, large enough to admit the tip of a grooved director, and upon it the capsule proper is divided along the entire length of the convex border of the kidney to a point half-way between the upper and lower poles of the organ, and the capsule, by blunt dissection on each side of the incision, is reflected forward and backward toward the renal pelvis to a point about midway between the external and internal borders of the kidney. This will leave one-half of the kidney denuded, the capsule being turned back upon it like the lapel of a coat. Two sutures are then placed, as is shown in the illustration (fig. 106) on the anterior surface of the kidney—one at the middle of the upper and one at the middle of the lower half of the organ. Two other sutures are placed at corresponding points on the posterior surface of the kidney. Each suture runs parallel to the long axis of the kidney, and is passed through the reflected capsule close to the line of the reflection, then through the underlying attached capsule, and runs along beneath the latter between the capsule and the kidney substance for a distance of two or three centimeters, when it again emerges through the attached and reflected layers of the capsule. A Hagedorn needle with a broad surface should be used, running it flatwise between the capsule proper and the kidney substance to avoid penetration of the latter. These sutures are then brought out to and through the muscles, but not through the skin, to a position corresponding to that in which they have been inserted. The wounds of the muscles and fascia are closed by from four to six sutures of forty-day catgut, passed in such a manner as to turn the raw surface of the quadratus lumborum toward the exposed kidney surface. This is effected by suturing the latissimus dorsi and the lumbar fascia forming the outer lips of the wound to the

latissimus dorsi, the sheath of the erector spinæ, and the outer lip of the open sheath of the quadratus lumborum at the inner margin of the incision. Then the eight ends of the fixation sutures are drawn tight so as to bring the denuded aspect of the kidney in contact with the raw surface of the quadratus lumborum, and the two ends of each of the four suspension sutures are tied to one another. The suspension and muscle sutures are buried by closing the skin over them with the intracuticular suture. By this method the denuded cortex of the outer half of the kidney is in snug contact with the raw quadratus lumborum through the entire length of the latter from rib to ilium. The dressing is placed across the entire width of the back smoothly and evenly.

Since a small kidney can be well exposed through this wound, the Edebohls incision is often best where stone is suspected. The small kidney can be removed through this incision, but where the organ is large, or a large abscess is present, or a graver condition exists, such as a suspected malignant growth, one of the other incisions more ordinarily used for nephrectomy or nephrotomy had better be employed. If, however, after making the Edebohls incision as described it should prove insufficient, and a larger one be required, one of the other kidney incisions may be employed; or, as an adjunct to this, if necessary, the opening can be made much larger than is ordinarily required.

This operation, or some modification of it, is the one recommended by the writers for the use of those operators who do not fear the after-effects of an adhesive inflammation that takes place between the kidney surface, when it is denuded of its cortex, and the muscles. It must be remembered, in this connection, that it is the adhesive inflammation that holds the kidney in place. At the present time, cases are being reported in which to anchor the kidney the stitches are taken through the true capsule and kidney tissue. As a result of passing ligatures through the kidney tissue, lines of scar tissue are formed, following the track in which the ligatures are placed.

If it is desired to anchor both kidneys, the same procedure as that outlined may be followed, anchoring one organ after the other has been secured. Or, if it is desired, through the Edebohls incisions made on each side of the erector spinæ, both kidneys

may be brought through the wound and exposed, for purposes of comparison.

Albarran[1] recommends, in anchoring a displaced kidney, if any hydronephrosis is present, the kidney be retained in such a position as to bring the ureteral opening at the most dependent part of the sac.

NEPHROTOMY

This term is used so generally that it comprises very often the exploratory incision just described as well as the continuation of such incision for a specific purpose, such as the removal of calculi or the drainage of a pus-cavity.

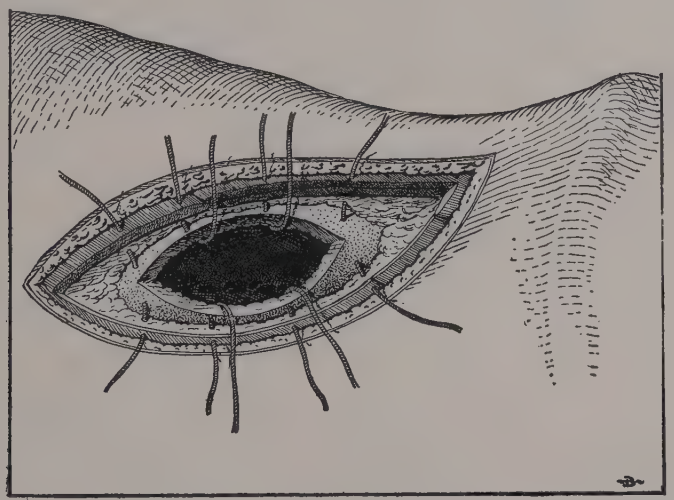


Fig. 107.—Method of attaching edges of kidney pocket to the abdominal wall (nephrostomy).

In performing this operation in the past it has been customary to employ the loin incision previously described. If the operation is done simply to open a pus cavity, the kidney should be freed and brought as far up into the wound as possible, carefully palpated, and an incision made into the most fluctuating portion of the mass. After this has been done and the pus has been allowed to escape, the cavity should be cleansed, a drainage-tube inserted to the bottom of the wound, and the muscles and skin sutured on each side as far as the tube. After a few days the tube may be re-

1 "Transactions Assoc. Français Urologie."

moved and a smaller one introduced, or the wound be packed with gauze, which should gradually be removed. By splitting the capsule of the kidney, pushing it back a little on each side, and then suturing the capsule to the walls of the wound a pocket is formed at the bottom of the wound, which may be kept open for observation as long as may seem desirable. The

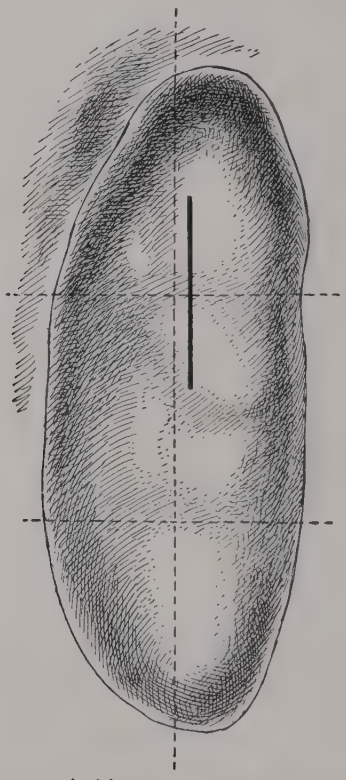


Fig. 108.—Showing exploratory incision on posterior surface of kidney (redrawn from Albarran).

French have applied the term *nephrostomy* to this procedure. If this operation is performed for the purpose of releasing infected urine from the kidney, rather than for simply effecting drainage of a pus-cavity, Albarran advises that drainage be instituted by the natural route in the following manner:

He catheterizes the ureter before the operation with a small ureteral sound introduced into the ureter as far as it will penetrate.

After the kidney is opened, it is easy to make this sound penetrate into the pelvis of the kidney; then a larger sound may be attached to this one and pulled down through until a No. 10 or 11 catheter can be passed. The first sound that is passed by the aid of a

Fig. 109.—Kidney having been delivered through opening, assistant compressing pedicle; illustrating the so-called postmortem incision for exploration of kidney.

cystoscope is generally a No. 6. When the end of the large ureter catheter has reached a suitable place in the kidney, it may be fastened there by means of a ligature running out through the

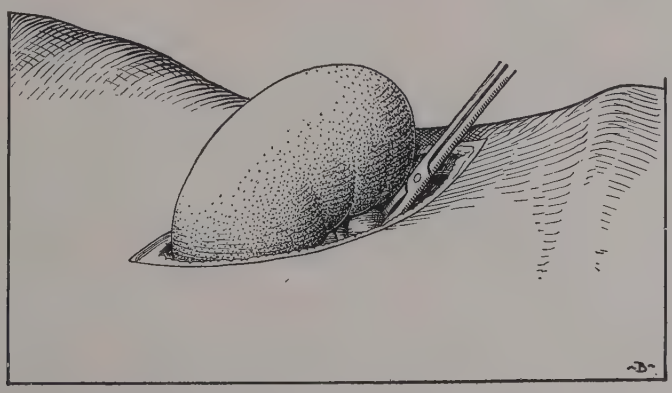


Fig. 110.—Showing method of applying clamp to pedicle when impossible to deliver kidney through opening (Berger and Hartmann).

lumbar opening, the other end of the sound, of course, protruding from the urethra. To remove the catheter it is only necessary to cut the thread and withdraw the catheter through the meatus.

Edebohls' incision may be used in performing nephrotomy when the kidney is not too large and there is a large space between the twelfth rib and the crest of the ilium.

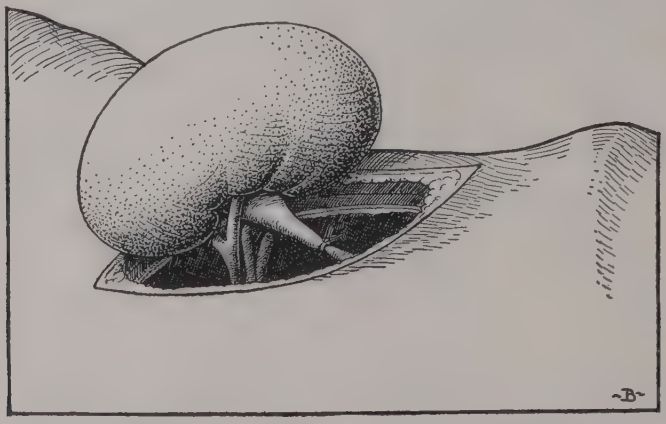


Fig. 111.—Ureter ligated, separate ligation of blood-vessels (Berger and Hartmann).

When the operation of nephrotomy is performed for the removal of stone, the kidney should be isolated as much as possible and brought well up into the wound. A temporary ligature should be

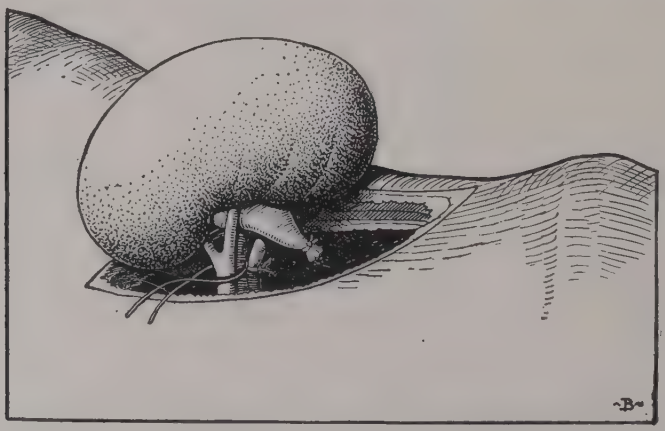


Fig. 112.—Ligation of ureter, kidney delivered through opening (Berger and Hartmann).

placed around the portion of the kidney that joins the ureter, thereby compressing the artery, or that portion of the kidney may be compressed between the thumb and forefinger of the assistant.

If a stone can be outlined, it can be cut down upon and removed, hemorrhage checked, and, if necessary, a few ligatures placed in the kidney substance. If the presence of stone is known, but cannot be positively located, the Albarran incision or some modification of it should be made into the kidney and a search of the kidney made, or, if necessary, the "postmortem incision," previously mentioned, may be used. When the stone has been found it should be seized between forceps designed for the purpose and removed; or, if closely encapsulated in the calices of the kidney, it may be removed with a curet. If the stone is very large and extends in various directions the incision may be prolonged in the direction of the stone, which can be broken up with forceps and the fragments removed.

After a stone has been removed, others should be searched for in the calices of the kidney. Retrograde catheterization of the ureter with an elastic bougie should then be performed, in order to determine that the ureteral canal is unobstructed. These various procedures having been carried out, the wound in the kidney should be sutured with two sets of sutures—a deep and a superficial set; the compression of the pedicle of the kidney may now be removed, the capsule of the kidney sutured, and the incision in the wall closed, with the exception of a short space in the lower portion of the wound, where a small drain may be placed for forty-eight hours. Some advocate, for the removal of stone, opening the ureters just below the pelvis of the kidney—an operation known as pyelotomy. If this is done, the pelvis of the kidney, easily accessible, may be examined through this opening by the finger and the stone extracted; afterward the wound should be sewed up and a drainage-tube inserted for a day or two, in case urinary leakage should take place. If practicable, a still better plan in these cases is to insert, in addition to the drainage-tube left in the incision, a ureteral catheter, introduced through the urethra.

NEPHRECTOMY

Nephrectomy is the operation by which the kidney is removed entirely or in part. The ordinary loin incision, as described in the operation of nephrotomy, is the one ordinarily employed for

this purpose, together with resection of a rib or a supplementary incision, if necessary, to obtain the proper amount of room. This procedure resembles the operation for nephrotomy just mentioned, until the kidney itself has been reached. The operation is comparatively easy, provided the kidney has not been very much increased in size and has many adhesions through some inflammatory condition, which may exist either in or around it or both. The great difficulty in performing this operation is to well isolate the pedicle, and to be sure that all the blood-vessels and the ureter are well ligated. The adhesions so apt to exist in the kidney necessitating nephrectomy sometimes render this procedure very difficult. The adhesions having been broken up as well as possible, the pedicle of the kidney having been carefully gone over by the examining finger, the decapsulation of the fatty capsule having been carefully performed, bearing in mind that the ureter is toward the bottom of the opening, an attempt should be made to isolate it and tie it between two silk ligatures. The ligature, the incision having been completed, which holds the severed ureter as separated from the kidney should be left long to facilitate further examination of the ureter. An attempt should then be made to deliver the kidney through the opening on to the loin. A double catgut ligature should be run through the middle of the pedicle so as to divide it in half and each half tied separately. A well-fitting clamp should be placed above these ligatures and the kidney removed above the clamp. The ligatures should be left long which have tied the pedicle, and for the sake of safety another ligature should be placed around the entire pedicle before the clamp is removed. Catgut No. 2 is sufficiently large for these ligatures. The severed end of the ureter should then be brought up into the wound, the ligature which controls it opened, and the permeability of the ureter ascertained through the passing of a probe. The end of the ureter can then be religated and cauterized with the actual cautery or a drop of carbolic acid. If more space is required, the operator should not hesitate to enlarge his original incision in the direction seemingly most desirable, so that the kidney may be well brought up into the wound, pushing before him, when possible, the peritoneum if it is reached.

It is recommended that, whenever possible, the blood-vessels and ureters be tied off separately, and in tubercular cases it is wise to tie off the ureter as low down as practicable, and not to forget to cauterize the end of the ureter left behind with a solution of carbolic acid, after which it should be wiped off with alcohol. The passage of a bougie into the ureter lends some aid in isolating it. If it is not practicable to separate the pedicle, so that the ureters and blood-vessels can be tied off separately, a ligature can be placed about the entire pedicle. In some cases it is so difficult to get at the pedicle that it may be advisable to leave clamps in place in the wound for twenty-four hours. Ordinarily, after the kidney has been removed, the wound may immediately be closed if no pus has been present. If the condition is a suppurating one, more or less inflammatory infiltration taking place into the surrounding tissues, it is advisable to leave the wound open and allow drainage to take place from a small opening at the lower angle. In suturing the wound after nephrectomy, whenever practicable, three sets of sutures should be employed—a deep set for the deeper muscles, a middle set, and a superficial set.

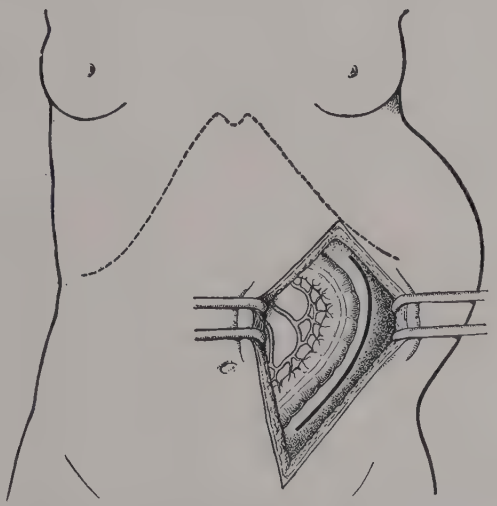


Fig. 113.—Showing curved line of incision in posterior peritoneal wall to avoid injury to blood-supply of colon in abdominal nephrectomy (Hartmann).

Abdominal or Transperitoneal Nephrectomy

The ordinary median incision, such as is used in making an exploratory laparotomy, is also employed for effecting removal of the kidney, or an incision may be made a little to the left or right of and parallel to the median line, as the operator may see fit. Proceed as in the case of exploratory laparotomy, until it becomes

necessary to incise the dorsal reflection of the peritoneum. When this has been done, the transversalis and fat should also be incised, when the kidney will be reached; if any adhesions exist, they should be broken up, the kidney delivered through the abdominal opening, and the pedicle tied off as in extraperitoneal nephrectomy. The opening in the posterior peritoneal wall should next be closed, and then the corresponding opening in the anterior peritoneal wall should be sutured.

Much has been written, particularly in France, about the danger of injuring the blood-supply to the colon, and in order to overcome this, some surgeons advocate the making of a curved incision in the posterior peritoneal wall, outside and parallel to the colon, as shown in the illustration (fig. 113). It is the practice of some operators to establish counterdrainage of the postperitoneal pocket, the place formerly occupied by the kidney, by making a counteropening through the loin.

Partial Nephrectomy

The practice of removing portions of the kidney the seat of traumatism or benign tumors is increasing. The operation is, of course, essentially nephrectomy, except that only a portion of the kidney tissue is removed. Hemorrhage must be carefully checked, and the edges of the kidney wound then brought together with one or two sets of Lembert sutures.

Although many of these operations are constantly being reported, sufficient time has not elapsed to attest the value of this procedure. Some compensatory kidney hypertrophy takes place, and a considerable portion of the kidney may be removed, and the remainder of the organ still continue to functionate, but in tuberculosis, suppurative kidneys, and malignant disease, although it often has been, and still is being attempted, the results of partial removal of the kidney are naturally not so good as in other conditions that make the operation necessary or preferable.

It would be interesting to know just how much kidney tissue can be removed, providing that left behind was in a healthy state, and still have the organ functionate. As far as we can tell at the present time, the amount is probably between one-half and one-third ordinarily. Experiments on animals would tend to

show that still larger proportions can be removed, and such operations have occasionally been reported as having been successfully performed on human beings.

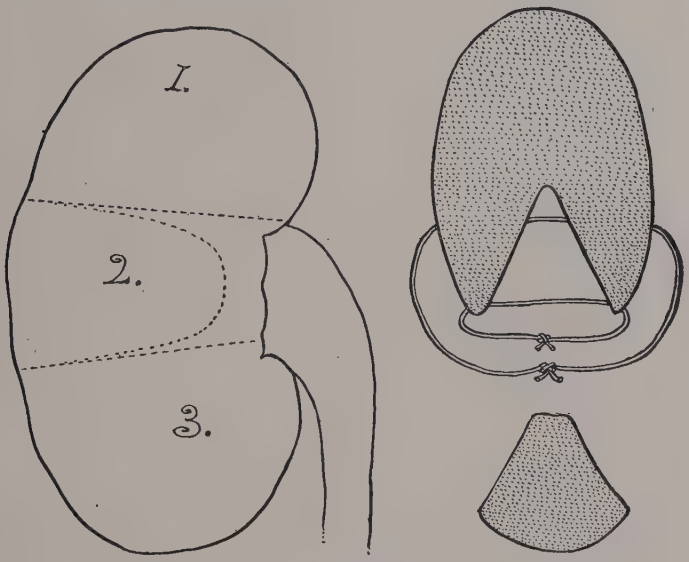


Fig. 114.—Diagram illustrating method of resection of kidney (redrawn from Pierre Duval).

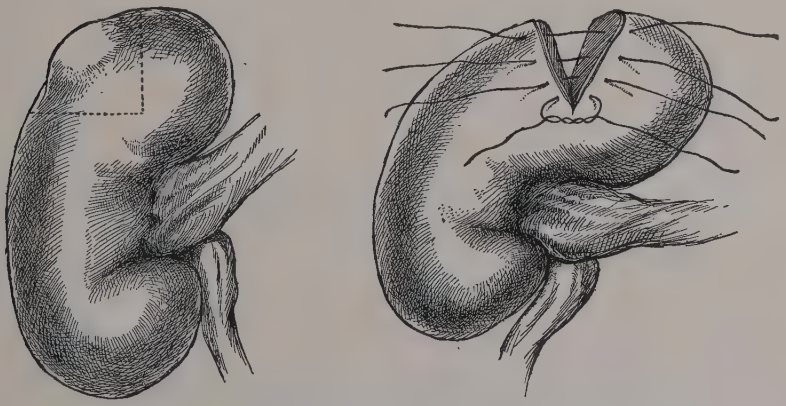


Fig. 115.—Partial resection of kidney (redrawn from Albarran).

Ordinarily, in order to have a good union in performing partial nephrectomy, a wedge-shaped or cuneiform piece should be removed from the kidney. When possible after a portion of the

kidney has been resected, the remaining parts should be brought together by a double set of sutures—a deep and a superficial one (fig. 114). Cases are commencing to be reported in which, for an injury or wound to the kidney, partial nephrectomy is being found to work successfully, and kidneys or portions of them which would in the past have been removed, are at the present time being saved. The operations for removing the kidney sac are discussed under the heading of the Surgery of Ureters.

One of the most difficult problems in surgery is associated with operations on the kidney when both kidneys are diseased. With increased frequency, owing to the refinements recently made in diagnostic procedure, is the surgeon confronted with the above condition. Naturally rules governing every case can only be formulated with great difficulty. *Tuberculosis* being the most common factor which involves both kidneys, ureter catheterization with a very careful estimation of the permeability of each kidney, according to the method referred to under that title earlier in this volume, should be carried out. In addition, very great attention should be given to the general conditions surrounding any particular case. As previously stated, tuberculosis of the kidney is more and more being observed to be part of a general systemic infection, and the conservative views as regards operative procedures and the good results to be obtained from them in tuberculosis of the kidney described in earlier editions of this work, we think that further experience has shown to be advisable. Except in rare cases no operation should be performed until the effects of open-air life have been previously carefully observed.

On the other hand, among these general factors, a strongly septic kidney, whether from tuberculosis or any other factor, may so imperatively require removal that it should be undertaken even if the other kidney is involved. Apparently the septic condition may, in rare cases, so embarrass the better kidney that the removal of the diseased one may improve the functioning of the remaining one. It is in cases like this that a great difficulty arises, because the results given by the tests for kidney permeability, as can naturally be seen under such conditions, are not infallible.

Concerning operations on a kidney where the other kidney is involved, due to stone in the kidney or kidneys, a different condi-

tion of affairs exists. Here the tests for kidney permeability are of very great value in showing whether the other kidney will be able to do the work. In other words, a condition may exist of two plus factors, one in each kidney, which combined will be enough to carry out the work of the system, in which case nephrectomy should not be performed, but every attempt made to preserve as much as possible the integrity of the remaining kidney tissue in each kidney. In cases of doubt generally an exploratory operation can be made, and each kidney palpated and carefully observed with no detrimental results in such cases unless inflammatory conditions exist in the kidney. Operating through Edebohls' incision is recommended. In cases of *tumor* of the kidney the same general rules apply as for stone in the kidney. A very careful examination should be previously made of the functioning power of the remaining kidney. Here the character of the tumor itself has a bearing on the subject as to whether it is malignant or benign. Two tumors of apparently benign character, one in each kidney, which show no indication of becoming malignant or giving rise to detrimental effect on the general condition, should probably be allowed to remain without operation, the individual being kept from time to time under observation. A case of this description has been observed by one of us for many years. The reader is referred in this connection to the other articles concerning tumors of the kidney and their diagnoses.

Remarks on Nephrectomy.—There is, at the present time, no one incision that may be considered as undeniably the best for the purpose of cutting into or removing the kidney. The choice of the incision to be used must depend largely on the particular case in hand and on the personal equation and preference of the operator. The somewhat brief description of the various operations on the kidney that has been given has reference to them as they are ordinarily performed. The surgeon familiar with abdominal work will be more likely to operate on the kidney through the abdominal route than one unaccustomed to it. This method is particularly valuable in those cases in which a large kidney is to be removed, an extensive renal tumor excised, or when it is found desirable to examine the appendix or other abdominal organs at

the same time. If the kidney is small and the space between the border of the twelfth rib and the crest of the ilium is wide, Edebohls' incision will permit examination of the kidney and probably serve for its removal.

For general purposes, the Israel incision, as illustrated (fig. 97), will be found satisfactory. This incision begins just below the border of the twelfth rib, about 3½ inches from the spine, runs downward and outward to a point about an inch above the pelvic rim, and then runs forward, keeping parallel with the rim of the pelvis and about an inch above it. The incision should cut deeply through the muscles of the back until the cavity in which the kidney lies is reached; it should then be carried onward slowly and carefully, deep retractors being used, until it is large enough to permit removal of the organ. Ordinarily, the peritoneum will be encountered at the junction of the incision with the anterior axillary border. At this point, if it is desired to carry the incision further, the peritoneum may be pushed ahead in front of the incision, without being opened. The same course is followed if the long transverse incision is selected. This incision is useful also in removing a large kidney or one to which a large growth is attached. Ordinarily, in performing nephrotomy or nephrectomy, the old-fashioned loin incision, as illustrated in fig. 101, is a serviceable one. If the Edebohls incision is selected in any given operation and it is found to be too small, the outer margin of the quadratus lumborum may be nicked near its insertion into the crest of the ilium, as suggested by Edebohls. This method is especially valuable when an examination of the appendix or other organs is to be made, with a view to removal.

In operating for removal of the kidney, the chief danger lies in hemorrhage, which is not ordinarily of the arterial type, but comes from the veins or from the small vessels of the incised kidney. Care should be used not to commence the incision too near the spine, the wounding of an intercostal artery giving rise to profuse hemorrhage.

Not infrequently, however, hemorrhage may seem more severe than it really is, due to the fact that the cavity takes on an exaggerated size, so that slight oozing may give the impression of serious loss of blood. In such cases it is aston-

ishing to observe how quickly bleeding will cease when slight pressure is made with gauze over the wounded surface of the kidney; this, followed by careful sponging to remove the collection of blood in the cavity, will leave a comparatively dry operative field. If much difficulty is experienced in tying off the ureter, the forceps may be allowed to remain in the wound for a few hours after the kidney has been removed. It seems hardly necessary to mention that a sufficient number of ligatures should be placed around the ureter and the adjacent blood-vessels to obviate secondary hemorrhage, and that after the kidney has been removed, no attempt should be made to close the wound unless it has been definitely ascertained that all bleeding has been checked.

Sometimes the pleura descends lower in the back than usual and may be wounded. If this accident occurs, it should be immediately sutured and care taken that the patient is kept on his back for several days.

The peritoneum is occasionally incised through inadvertence. The incision should be immediately reunited with fine catgut.

The fatty capsule when met with should preferably be incised a few inches on a director, as the finger can be more easily introduced than if it is torn through. After the finger is introduced it should be swept around over the surface of the kidney, patiently freeing the organ from the adhesions between its surface and the fatty capsule; then when it is well freed, if the fist of the assistant makes firm counterpressure over the abdominal wall, it will aid materially in delivering the kidney through the opening if the loin incision has been employed. Sometimes the fatty capsule and true capsule are almost grown together. In operating on a pus kidney, if the abscess in the kidney is localized, it is as well to remove as little of the fatty capsule as may be required to properly locate and drain the abscess, so as to prevent infiltration as much as possible into the surrounding tissues. It is easy to isolate the ureter from the web-like tissue that surrounds the ureter and blood-vessels if it is remembered that in the loin incision the ureter is toward the lower end of the incision.

Under ordinary circumstances, after the removal of a kidney in which no pus is found, the wound may be closed immediately

with three sets of sutures, two going through the muscles and one through the skin. In performing nephrectomy in the presence of an abscess cavity either in the kidney or in its immediate neighborhood, a drainage-tube should be inserted following the operation, and the cavity treated as in the case of a pus-cavity existing elsewhere in the body.

In the removal of a kidney, besides the difficulties that occur because of the size of the organ and the presence of adhesions, in very rare cases of renal or perirenal abscess the kidney itself is hard to find, and sometimes, strange as it may seem, it cannot be discovered at all, having been so extensively destroyed as practically to have disappeared. In these cases, if a drainage-tube has been inserted, all goes well while the tube is in position, but after its removal recurrent abscesses or cysts are likely to form. In such patients the use of a permanent drainage-tube in the loin is indicated; this tube, while it may cause considerable inconvenience, will not necessitate confining the patient to bed, nor will it hinder him from performing his customary duties. Suppurating kidneys that it is found difficult to remove at first may, after the pus-cavity has been drained, be removed at a second operation with more ease.

In removing the kidney it is advisable, under ordinary circumstances, to tie off the blood-vessels as the operation progresses, instead of, as is often the custom in similar operations, to allow the artery forceps to remain on any bleeding vessels until after the operation is nearly completed. The operator will then not have the forceps in his way, as might otherwise prove the case. Care should be used in making the slight incision through the fatty capsule before stripping it off from the capsule proper to avoid, if possible, nicking the kidney surface. In dealing with a pus kidney or a sac kidney the wall is apt to be very thin between the cavity and the capsule of the kidney, and, therefore, easily punctured. It is unwise to flood the field of operation with pus or other contents of the sac if it can be avoided. It very rarely happens, but it may occur, through the size of a tumor, through adhesions, or through some malposition, that it is almost impossible to reach the ureter and its accompanying blood-vessels so as to tie off the pedicle of the kidney. In such a case either pole of the kidney may be

decapitated and large forceps put across the stump so as to arrest the hemorrhage. This having been done, the pedicle of the kidney can then be reached and tied off. The kidney will then only be attached by the remaining pole, and can be easily removed. The question of **renal** or **perirenal fistula** and their prevention and treatment has been well discussed by Albarran in his recent work. A frequent cause of fistula is the imperfect breaking down of pus cavities which may exist at the time of an operation on a pus kidney, or for the removal of stone from an infected kidney. Naturally, relief follows another operation if the pus pockets are so broken down and proper drainage can take place. Or, if any pus pocket can be found around the kidney, drainage of such a cavity will effect a cure. Sometimes curettage of the tissues surrounding the kidney will be found effective. If the fistula secretes urine as well as pus the permeability of the ureter should be looked into, and the effect, if possible, of the ureter retention catheter tried for several days before operating. A simple urinary fistula may be cured by such measures, or a ureter retention catheter used following a nephrotomy and allowed to remain a few days after the drainage-tube through the loin has been removed, may prove of valuable service. Unfortunately, the experience of most operators in this country does not bear out their European colleagues, either as regards the ease with which the ureter catheter can be introduced, or its size, or the duration of time which it can be retained without becoming incrusted. **Nephrectomy by morcellement** is the name applied to this operation. In performing this, as in all operations on the kidney, great care should be used in the selection of the clamps. Those used should lock firmly, when no space should exist between the blades. Clamps which tear through the structures should not be used. Right-angled clamps will sometimes be found of use in performing nephrectomy. In partial or complete nephrectomy, at least a quarter of an inch of tissue should be left on the outer side of the clamp, so that the pedicle or any portion of the kidney held by the clamp may not slip out from under it when the kidney is removed. We consider this advice important, as failure to carry out this detail in an operation performed by one of us was responsible for the severed pedicles slipping from under

the clamp. When this unfortunate accident occurs, immediate attempts should be made, through the means of long forceps, to catch the bleeding vessels at the bottom of the cavity. This done, difficulty may be experienced in ligating them beyond the end of the clamp at the bottom of the cavity, but a series of ligatures surrounding the clamp into the surrounding tissues, each put a little lower than the other, will make it possible to eventually ligate the vessel beyond the end of the clamp. Following nephrectomy, the cavity should be carefully examined with a portable electric light to see that no bleeding points remain or tear in the peritoneum exists.

In **removal of tumor of the kidney** the operator should be guided to a great extent by the conditions present in any given case, and whether nephrotomy, nephrectomy, partial or complete, or nephrectomy with ablation of the ureter as completely as possible, should be done will depend upon the circumstances surrounding any given case, such as the nature of the tumor, its get-at-ability, and the condition of the other kidney.

Cysts of the kidney, when due to such conditions as hydatids, should be removed entire without being opened, the kidney sewed up, and preserved. In malignant tumors or tubercular growths nephrectomy should be performed. Albarran states that when he operates on both kidneys he always operates on the best one first in order that he may know and have some idea as to how much healthy kidney tissue there is in the body. Many surgeons prefer the abdominal route for the excision of large tumors. It is astonishing what little difference there is in the death-rate between the abdominal route and the extraperitoneal route, as shown by statistics in nephrectomy. It is recommended in operating for malignant tumors that care should be used to remove the suprarenal capsule and ganglia as much as possible; this applies only to one-sided growths.

Nephrectomy should be performed for tumors of the pelvis of the kidney. These tumors are comparatively rare, and are most often papillomata. When possible, it has been recommended, in such cases, to remove the ureter completely, as papilloma of ureter is apt to be present. Tumors of the capsule of the kidney, under ordinary circumstances, if benign, should be removed without

removal of the kidney. Nephrectomy is the operation for tumors of the kidney in children, which are almost invariably malignant, and generally, even after successful removal, recur. In some cases microscopic examination of the tumor at the time of operation may aid, but it is apt to be unsatisfactory.

Mayo, of Rochester, has invented a table, or an appropriate top for a table, on which to perform operations on the kidney, of which there is an illustration in this work (see fig. 99).

DECAPSULATION OF THE KIDNEY

This procedure has already been spoken of in connection with the operation for nephropexy. The kidney having been reached

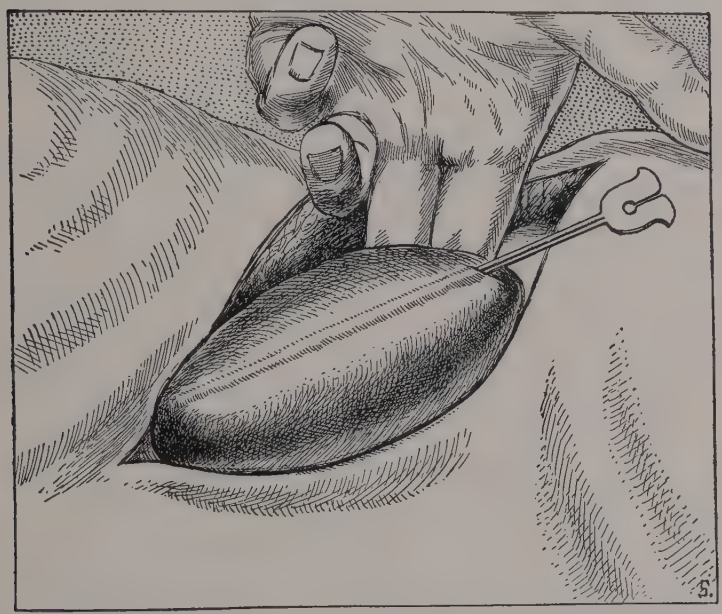


Fig. 116.—Decapsulation of the true capsule of the kidney (redrawn from Albarran).

through Edebohl's incision, or through the ordinary loin incision, the fatty capsule having been removed, the true capsule of the kidney is incised on a director and the capsules shelled back to as great an extent as desired, and what may be considered necessary removed, care being taken not to injure the parenchyma of the kidney. The amount of hemorrhage is generally

slight and easily controlled. Cicatricial tissue in a short time forms over the decapsulated area. The operation has sometimes been repeated several times on the same individual, the new capsule made up of the cicatricial tissue itself being removed. The usefulness of this operation alone in the treatment of Bright's disease has in the past by some operators been overestimated. The decapsulation in whole or in part is in some conditions a component part of other operations on the kidney.

SURGICAL TREATMENT OF BRIGHT'S DISEASE

The treatment of interstitial nephritis and pyelonephritis by means of *continuous catheterization of the bladder* has been advocated by Arthur T. Cabot,[1] who endeavors by this means to secure rest for the inflamed and weakened kidneys. The method is recommended in cases in which there is interstitial nephritis in the aged, associated with a frequent desire to micturate and but little inflammation of the bladder, or slight obstruction at its neck. The writers have seen such cases clinically, and believe they are not infrequent, although postmortem evidence as to just the anatomic condition at fault is lacking. Such a procedure may be of use in cases in which the weakened state or other conditions render more active procedure impossible or inadvisable. This procedure has been referred to earlier in the volume under the general subject of Drainage. Clinically we have met with a class of individuals among the aged who have never had treatment for obstruction at the neck of the bladder who give a history of having had a dribbling of urine extending over a considerable period of time. They will be found on catheterization to have an immense amount of residual urine in the bladder; in some of our cases as much as 2 quarts. In these individuals the amount of residual urine bears very little relation to the obstruction to urination, although some enlargement of the prostate generally exists. They have an interstitial nephritis and probably some hydro- or pyonephrosis which may not be marked. The interstitial nephritis may be a little hard to diagnose, al-

[1] "On the Treatment of Interstitial Nephritis and Pyelonephritis by Continuous Catheterization of the Bladder," "Boston Medical and Surgical Journal," 1904.

though the urinary solids will generally be found to be somewhat diminished, but the patients themselves seem to be suffering from a general intoxication due to the absorption of urinary products, and have such symptoms as indigestion, coated tongue, and a marked urinous odor is apt to pervade all their surroundings. This is the type benefited by the continuous catheterization.

Many surgeons have for some time past been advocating the operative treatment of Bright's disease, but the results of these operations thus far have not, in our opinion, been attended with the desired success. By their efforts, however, the subject of kidney surgery has been broadened, and they have, in addition, improved the operative technic and given a clearer conception as to the extent of surgical interference that will be tolerated by the kidney.

It has long been known that in certain cases of persistent renal hemorrhage relief will follow an incision into the kidney. This is probably due to the fact that tension is thus relieved, and that the formation of cicatricial tissue, which apparently follows decapsulation, does not take place after incision. The operation is, therefore, to be recommened in certain cases of nephritis attended with hemorrhage. For suspected nephritis with persistent pain in and around the region of the kidney, it may be advisable to make an exploratory operation. If no exciting cause is found outside the kidney, splitting of the capsule of the organ should ordinarily cause but slight damage, and may give an insight into the true state of the kidney. In some cases this procedure may give diagnostic aid; it should not be performed too frequently, but reserved for those cases in which the most exhaustive general measures have failed to lead to a correct diagnosis, and in which careful, painstaking, and prolonged treatment by nonsurgical methods has given no relief from hemorrhage or pain. Opening and draining the pelvis of the kidney for *anuria* due to the presence of renal calculi or when symptomatic, as from pregnancy, may save or prolong the life of the individual, and in some rare cases of partial anuria may be the last means of overcoming uremic intoxication which is progressively growing more marked, and for which no other measures have been able to afford relief.

It is to be hoped that in the near future clearer views will be had as to the proper procedures to adopt in the surgical treatment of Bright's disease than at present exist. One reason why the statistics on the operative results of the past are of so little value is that the diagnosis of the disease and the amount of improvement following the operation have been based on the results of urinary examinations, which have been shown to be often misleading.

While our experience has not been such as to convince us of the great benefit to be derived from the operative procedures advocated for the cure of Bright's disease itself, it has been such as to lead us to believe that, through increased ability on the part of the profession to diagnose diseases of the kidneys, there will be a corresponding increase in the number of diseased conditions found that will be amenable to surgical treatment.

LAVAGE OF THE PELVIS OF THE KIDNEY

Lavage of the pelvis of the kidney through the ureteral catheter is so easily carried out, once the physician becomes familiar with ureteral catheterization, that the method is now being frequently employed for the relief of pyelonephritis and its allied conditions. The solutions generally employed are silver nitrate, not stronger than 1: 10,000, boric acid, argyrol, protargol, or albargin. Ordinarily, the irrigations should not be made oftener than once a week. The ureteral catheter having been introduced, the contents of a small syringe, containing from 1 to 4 ounces of the solution, are very slowly injected through the outer end of the catheter, the syringe is removed, and the injected fluid is allowed to flow out through the catheter. The catheter is then removed, or a small amount of fluid may be injected as the catheter is removed with the object of distending the pelvis of the kidney and the ureter. If too much or too strong a solution is used, renal colic may ensue; the procedure is often followed by a sensation of fulness in the kidney. Albarran is a warm advocate of the usefulness of irrigations of the pelvis in pyonephritis through a retention catheter for several days before an operation, as he thinks by disinfecting the pelvis of the kidney better after operative results than would otherwise occur will ensue.

Judging from the carefully recorded histories of the cases of Casper and Richter, the results following the use of this method are not such as to encourage the belief that practical benefit will accrue in any large number of cases. In certain cases it apparently tends to hasten the disappearance of pus in the urine in cases of pyelitis.

The chief difficulty that confronts us in estimating the true value of the aforesaid procedure in the treatment of pyelonephritis is that a correct diagnosis is not always possible, some observers considering pyuria to be present when only a few leukocytes are found in the urine. Repeated investigations will be necessary before a correct estimation of the benefits to be derived from this procedure can be safely made; the writers believe that it has but a limited range of usefulness.

CHAPTER XVII

ANATOMY, PHYSIOLOGY, AND PATHOLOGIC ANATOMY OF THE URETER

ANATOMY AND PHYSIOLOGY OF THE URETER

The ureters are hollow tubes, from fourteen to sixteen inches in length, that conduct the urine from the kidneys to the bladder. Embryologically, as anatomically, they are direct continuations of the pelvis of the kidney and they are formed from an offshoot of the Wolffian duct. They lie behind the peritoneum, and enter the bladder at its base in an oblique direction, in such a manner than when the bladder is distended, the resulting pressure automatically closes the ureteral orifice. They are made up of an inner mucous membrane of transitional epithelium, laid down upon a delicate supporting tissue, external to which is found a coat of smooth muscle, consisting of an internal longitudinal and an external circular layer. This is invested by a fibrous connective-tissue sheath in which circular elastic fibrils are plentiful. Normally, the walls of the ureter are collapsed and in contact. Cross-sections show the collapsed lumen thrown into longitudinal folds giving a stellate outline. The normal distended lumen measures but from two to four millimeters in diameter. Under numerous conditions, as in hydronephrosis or pyonephrosis, however, it may become considerably dilated, and may even permit the passage of a stone 2 cm. or more in diameter. As a rule, however, stones of this size are almost certain to lodge in the renal pelvis, or if they enter the ureter, at the entrance to the bladder.

The propulsion of the urine through the ureter is not a simple matter of gravity, but takes place as a result of peristaltic waves, originating in the pelvis of the kidney and passing downward. These contractions occur every few seconds and force the urine before them by a series of rhythmic spurts. This peristaltic mus-

cular action accounts in large measure for the facility with which masses of necrotic tissue or calculi are forced through the lumen of the ureters.

The ureter receives its nerve-supply from the inferior mesenteric, spermatic, and hypogastric plexuses. Its contractions are, however, probably due largely to automatic muscular movements.

PATHOLOGIC ANATOMY OF THE URETERS

Malformations of the ureters are by no means uncommon, one of the most frequent of these being an unusual point of entrance into the bladder. At times both ureters discharge through the same papilla, or occasionally only one ureter exists, associated perhaps with horseshoe kidney or some other renal abnormality. These variations should constantly be borne in mind in performing cystoscopic examination.

Most of the pathologic changes of the ureter are practically identical with those of the renal pelvis or bladder. It is therefore chiefly concerned with various inflammatory diseases, and with the results of and the passage of urinary calculi.

Tumors of the ureters are papillomatous, cystic, or carcinomatous in type. They are almost invariably associated with, or a part of, growths in one of the adjacent organs, especially in the bladder or kidney. Primary growths of the ureter have been reported, but are so rare as to be regarded in the light of surgical curiosities. In the writers' experience but a single primary tumor of the ureter has been found—that an epithelioma situated near penetration of the bladder-wall.

Cysts of the ureter are occasionally reported; two such cases were presented before the New York Pathological Society during 1907 (Bond Stow, Otto Schultze), and a considerable series of these cases has been collected by Harris.[1] They are of relatively small clinical importance, though most interesting from the pathologist's standpoint. They are probably inflammatory in origin.

Inflammation.—The ureters are histologically a continuation of the bladder structures and, to a considerable extent, of that of the urethra; hence when subject to irritation, similar conditions as occur in the bladder and urethra will naturally ensue after infection

[1] "American Medicine," vol. iii, p. 731.

or irritation from any cause. Obstruction of the mouth of the ureteral glands gives rise to an exudative inflammation with ulceration or cyst formation, the ureters showing a particularly strong tendency toward the development of these cysts. As a final result of acute inflammatory processes there is a predisposition to the formation of scar tissue, resulting in stricture; nevertheless, in studying the literature on the subject of diseases of the ureters it is somewhat astonishing to observe with how little frequency **strictures of the ureter** have been reported. As the result of the writers' observations, moreover, they believe that stricture of the ureter is not so infrequent as is commonly supposed, and that the subject is worthy of more attention than it has received in the past. Attempts at catheterization of the ureters have recently resulted in the finding of an increased number of such strictures. As illustrative of a not uncommon class may be cited a case that recently came under the care of one of the writers. On attempting to catheterize the left ureter, renal calculi being suspected, although the mouth of the ureter could be made out and there was apparently no other obstruction, still it was found impossible to pass a very small catheter—the smallest available—because of contraction of the mouth of the ureter. No history or clinical sign indicative of ureteral stricture was manifest.

Stone.—A stone in the kidney, as it works its way down into the ureter, gives rise to intense pain of a stabbing or burning character. This pain begins in the back, extends around to the side and down the groin, in a manner characteristic of almost all forms of renal colic. Not very infrequently a stone lodging in the ureter will cause a distention of the tube and set up hydronephrosis. These cases are generally differentiated easily from diseased conditions of the cecum or appendix, by the usual clinical signs, and examination of the urine either with or without cystoscopy is a method of great assistance.

The ureters occasionally suffer from *traumatism*, although they are so well protected and are placed so deeply that injuries are comparatively rare. A few cases have been reported as the result of knife and shot wounds.

The ureter is frequently diseased as the result of downward

extension of a lesion of the renal pelvis, or it may suffer from invasion by way of the bladder. In some severe types of urethral stricture with retention of urine dilation of the ureters occurs. Fig. 117 illustrates such a condition. This principle is applied in the treatment of calculi retained in the ureter, and it has been suggested that the bladder be distended with some warm fluid;

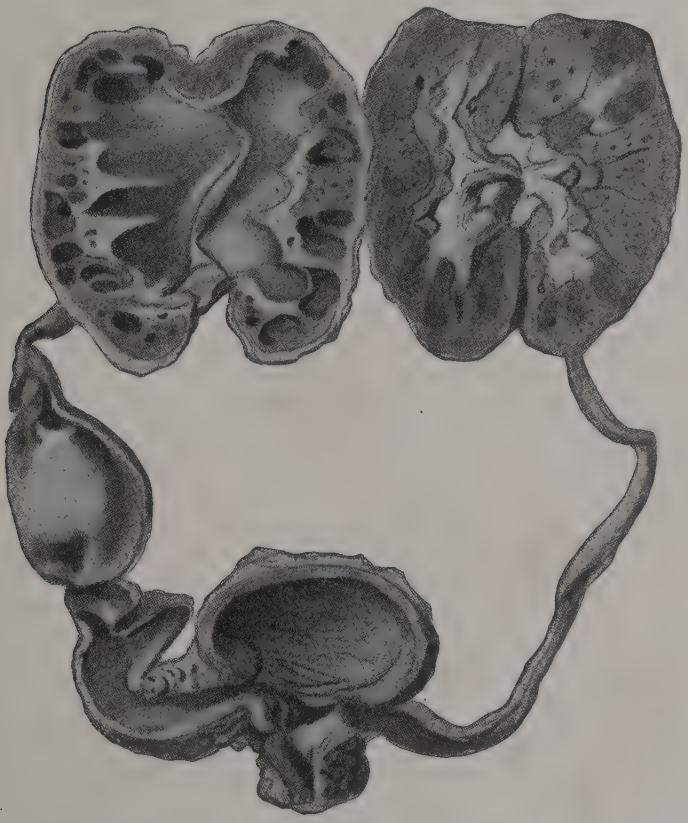


Fig. 117.—Showing dilation of the ureters and pelvis, with excavation of the pyramids, caused by long-standing stricture of the membranous urethra (one-third natural size) (specimen from the Museum of Carnegie Laboratory).

the walls of the ureters might thus be increased in diameter, permitting the stone to pass through more easily.

Tuberculosis may attack the ureter as the result of the extension downward of tuberculous disease of the kidney, or by an upward extension from a similarly diseased bladder. The

process is said occasionally to give rise to distention of the ureter or to its obliteration by stricture formation.

Much has been written about **kinks in the ureters,** particularly in connection with floating kidney. The so-called Dietl's crisis, described elsewhere, is believed to be due to this cause, a belief that is not fully borne out by postmortem findings. The writers explain the occasional occurrence of this symptom-complex as being due to spasmodic contraction of the ureter under certain nervous stimulation similar in nature to like spasmodic contractures of the urethra or esophagus. These contractions are believed to be accelerated or inaugurated by any slight local lesion that exists in the ureter. In some cases the gravid uterus may press so severely on the ureter as to cause obstruction or even serious damage to the tube.

Not infrequently the ureter is the seat of **stricture** or **fistula,** the result of injury inflicted on the tube or adjacent tissues during operation or from the passage of stone. The fistula due to injury of the ureter following operative procedures manifests itself by the presence of the perforation either at the site of the original wound, or perhaps in some other structure of the body by the discharge of urine. Wounding of the ureter during the course of an operation is generally made apparent by the immediate presence of urine in the wound. The ureter is occasionally tied during an operation, particularly on the uterus or its appendages. If both ureters have been ligated, there is an immediate cessation of the urinary flow. On attempting to pass a ureteral catheter an obstruction will be encountered, which, together with the total suppression of urine, will generally disclose the condition. Fortunately, in such cases, when the wound is reopened and the ureters are freed, they will ordinarily resume their function even if the constriction has existed for several hours. If only one ureter has been tied, and the condition remains unrecognized, hydronephrosis ensues. If the ureters have been tied off but a little distance from the kidney, this will probably manifest itself in a few days by the occurrence of a swelling, owing to the distention caused by the retained urine in the kidney; or, on the other hand, there may be marked distention of the ureter, giving rise to a tumor that, on being opened, will be found filled with urine.

Wounds of the ureter discovered or inflicted during operation may be immediately sutured, with or without the introduction of a ureteral catheter. In suturing wounds of the ureter that have been made for the removal of calculi, great care should be exercised not to penetrate the mucosa of the tube. Fine silk ligatures, which may afterward be buried in the tissues, or any very rapidly absorbing catgut, may be used. In such cases it is well to leave a drain at the angle of the wound for a few days lest leakage occur. In such a case recently under the writers' care a ureteral catheter was allowed to remain with its extremity in the pelvis of the kidney for thirty-six hours, after which it was removed; no further leakage occurred. The treatment of wounds is again referred to in the chapter on Surgery of the Ureters.

When a stone in the ureter has become impacted and makes no further progress toward the bladder, it may occasionally be pushed up toward the kidney and thus easily reached through a lumbar incision. The various operative procedures for the relief of diseased conditions of the ureters will be described further on; it remains to consider here briefly the methods of inspection of the ureters as an aid to the diagnosis.

Diagnosis.—The value of the *x*-ray and ureter catheterization for diagnostic purposes is so well known as to require nothing but mention here. The *x*-ray used in conjunction with a 15 per cent. injection of argyrol will to our knowledge show on the plate a kink in the ureter. Palpation of the ureters when carefully practised is occasionally of considerable aid in diagnosis. In the chapter on Diseases of the Kidney the valuable aid that may be obtained from palpation and massage along the course of the ureters in the diagnosis of pyuria has been mentioned. Other things being equal, it follows that a bimanual examination of the ureters may be more easily made in a thin than in a stout subject. Continual practice, however, will increase the skill of the examiner.

It has been claimed that, by the introduction of a finger into the rectum above the prostate, diseased conditions of the ureters can sometimes be detected. The writers have never been able to determine to their satisfaction that a lesion of the ureter could be thus accurately differentiated from an enlarged and diseased seminal vesicle. This method of examination is, however, recom-

mended by some. In a woman it may be possible, with one hand on the abdomen and a finger in the anterior vaginal culdesac, to outline a swollen ureter, but great care must be observed not to confound this condition with some diseased state of the ovary, tube, appendix, or intestine.

As has been said, the two greatest aids that are at our command in diagnosing diseased conditions of the ureters are ureter catheterization and the *x*-ray, or a combination of both.

The *x*-ray, in the hands of one skilled in its use, will sometimes demonstrate the presence of a stone in the ureter very clearly. Some admirable specimens of this work have been made, illustrating the passage of the stone down the ureter into the bladder. The pictures were taken in frequent succession, and showed the stone in many positions in the ureter as it proceeded on its journey. A good illustration of the aid to be obtained from a combination of the two methods was the taking of an *x*-ray picture of a subject in whom a metal ureteral catheter had been introduced from the bladder into the kidney. The metal catheter was distinctly seen in the picture, and outlined the course of the ureter very clearly. It is doubtful, however, if the adoption of this procedure as a routine practice for the determination of the movability of a kidney, as recommended by some, will ultimately be of great value. Metal catheters, after all, must be used with considerable care in the ureters and are not to be employed in all cases, but, as has been mentioned under the head of Floating Kidney, metal catheters introduced through the ureter into the kidney, followed by the taking of a radiograph, are very helpful in those cases in which it is necessary to differentiate between a floating kidney and a new-growth.

CHAPTER XVIII

SURGERY OF THE URETERS AND FOR THE RELIEF OF HYDRONEPHROSIS

Much has been written in the text-books on surgery regarding the various routes by which the ureters may be reached. For practical purposes, the lumbar inguinal incision, as illustrated in the cut (fig. 111), will enable one to find the ureter in most any portion of its course. The incision may be begun just below the twelfth rib, or further along toward the inguinal region, and may be prolonged as far as necessary, the peritoneum, when met with, being pushed ahead of it. Instead of making the very long incision, as shown in our plate for discovering the kidney and ureter in full length, if it is desired to reach the ureter in its pelvic portion a shorter incision may be used, and the one advised by Albarran, as shown in the illustration, is the one recommended. In this case the skin and muscles should be cut through to the peritoneum; this bifurcation of the iliac should be searched for as being the guide to the ureter. The incision should begin a finger-breadth above the cervical arch, and run parallel to Poupart's ligament until it arrives at the level of the anterior superior spine of the ilium, and then go up vertically on the abdominal wall until it has reached a distance of about three fingers' breadth above the spine. If it has been possible beforehand to introduce a ureter catheter, it will be an easy matter to locate the ureter, otherwise it will be found lying in and just outside the fold of the peritoneum. If it is desired to reach the ureter in some portion very near the bladder, a suprapubic section will permit of the exploration of the ureter from its inner surface. Fenwick suggested and Albarran recommends that in certain cases where there is such a condition as a large stone in the ureter near the opening of the ureter into the bladder, it can be reached through a perineal incision, an operation of the same character as that of

Albarran for the removal of the prostate being performed, and the space back of the bladder being well opened up, it will be very easy to locate the ureter and operate upon it through this channel, the size of the calculus making it easier to find. The use of the *x*-ray, which has been previously mentioned, is of particular value in the diagnosis of ureteral calculi. The ureter may also be

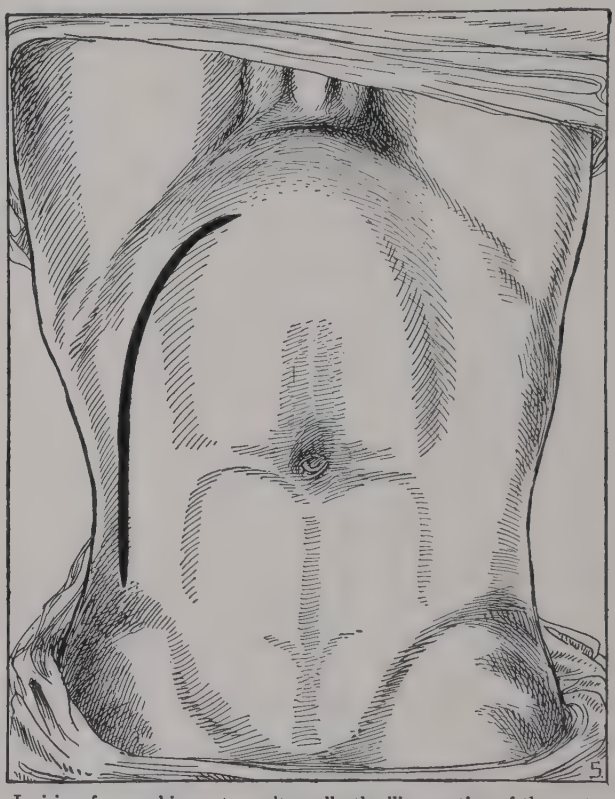


Fig. 118.—Incision for reaching extraperitoneally the iliac portion of the ureter (redrawn from Albarran).

reached through an abdominal incision, in much the same manner as the kidney is reached; or by finding the posterior wall of the bladder, the ureter may be followed along its course.

Statistics show that the best results are obtained if the ureter can be reached by the extraperitoneal route. The increasing facility with which ureter catheterization can be performed, being

often a comparatively simple procedure, will aid one in finding the canal if a ureteral catheter has been introduced previous to the operation. Gynecologists, in operating on ovarian tumors,

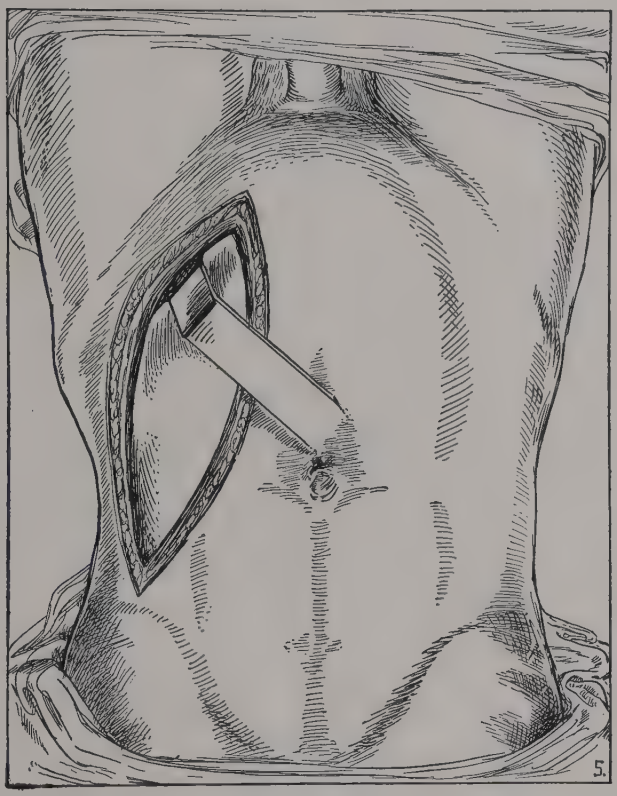


Fig. 119.—Rolling back the peritoneum in the iliac fossa (redrawn from Albarran).

will undoubtedly find this of service, since by its use, in certain cases, wounding of the ureter may be avoided.

For purposes of description operations on the ureter may be divided into three principal classes: (1) Operations involving the opening of the ureter into the kidney; (2) operations concerned with the portion of the ureter that opens into the bladder; (3) operations for wounds of the ureter or for the removal of stones from, or for the relief of strictures of, the ureter.

Class I.—The operations coming in this class are most gener-

ally practised for the relief of renal retention of urine. Several of the conditions in which these operations are indicated are shown in the illustrations. In some cases the pelvis of the kidney becomes so greatly distended as the result of hydronephrosis that almost the entire length of the ureter has to be resected

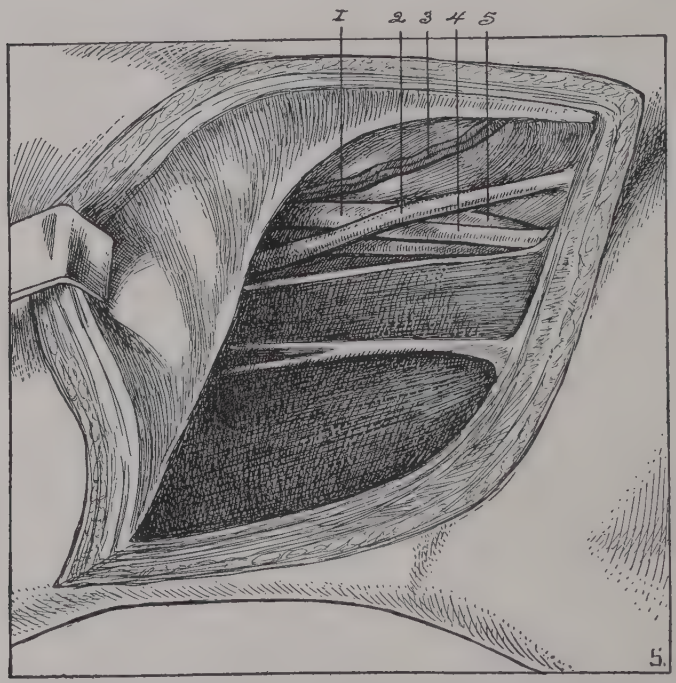


Fig. 120.—Showing the ureter in the right iliac region: 1, Common iliac artery; 2, ureter; 3, spermatic vessels; 4, external iliac; 5, hypogastric artery (redrawn from Albarran).

and the kidney pelvis fastened directly to the bladder. When the hydronephrotic kidney assumes the form of a pocket that hangs down beside the ureter, a direct anastomosis may be made between the lower portion of the sac and the ureter. In these cases valves may form between the ureter and the pelvis of the kidney; such valves may generally be destroyed by incision. Israel and Albarran have advocated the suturing together of the renal pockets that sometimes form, in cases of hydronephrosis, behind the ureteral opening. The suturing together of the pocket should be done in such a manner as to prevent the urine

from accumulating in the back part of the pouch. In order that these operations be successful it is necessary that the renal pocket be shallow. When a thick pocket, containing some of the kidney tissue, exists below the opening of the ureter, resection of the portion of the kidney beneath the ureteral opening may be performed.

The **operation of Küster**[1] is only performed for very tight stricture of the ureter. The ureter is cut off obliquely below the stricture, an incision is made in the anterior surface of the ureter,

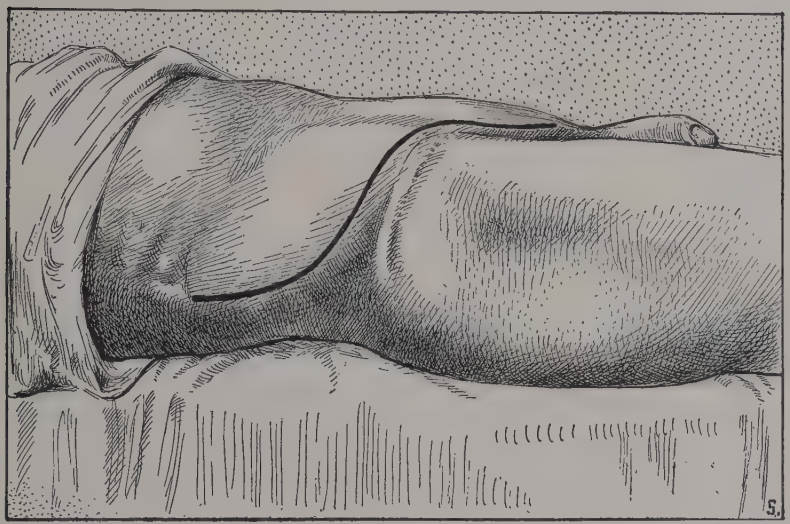


Fig. 121.—Lumbar iliac incision for discovering the kidney and ureter in its whole length (after Pierre Duval).

it is drawn into an opening in the anterior surface of the pelvis, flattened out, and sewed in place. The primary wound in the sac of the pelvis is sewed up (fig. 122).

Trendelenburg[2] recommends the following **operation for hydronephrosis:** A lumbar incision is made, the sac punctured with a trocar and opened by incision. The redundant portion of the sac and the included portion of the ureter are dissected off. The stump of the ureter is then sewed into the lowest portion of

[1] Frisch and Zuckerkandl, 1904.
[2] "Deutsche Zeitschrift für Chirürg.," 1904.

the remaining sac. The incision into the sac is then sutured. A small drain is placed in the ureter and another in the pelvis, both leading out through lumbar wounds.

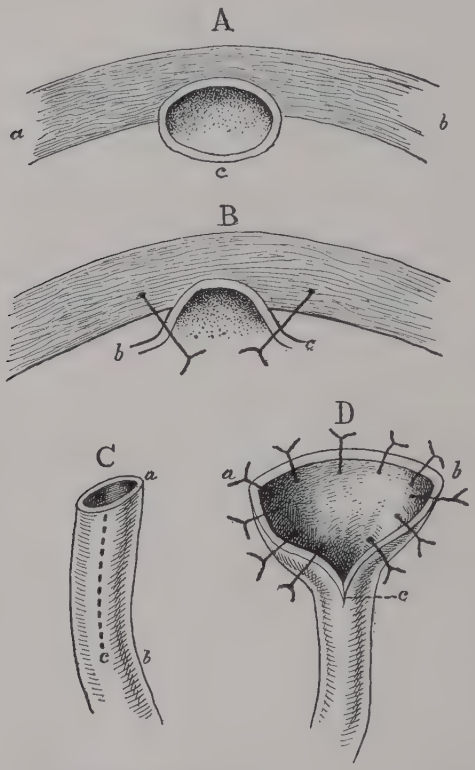


Fig. 122.—Ureteropyeloneostomy (Küster): *A*—*a*, *b*, Sac-wall; *C*, incision through ureter; *B*—*b*, *c*, anterior surface of split ureter, with sutures that draw up surfaces of ureter to wall of pelvis; *C*—*a*, upper end of ureter; *a*, *c*, anterior incision of ureter; *D*, ureter laid open after incision (redrawn from Frisch and Zuckerkandl).

An illustration (fig. 123) is also furnished, showing the method of destruction of the renal valves which so frequently form between the pelvis of the kidney, and the ureteral opening, where a hydronephrotic sac is present. It is easily seen how the anterior wall of the valve is divided, being held between two forceps, and the subsequent suturing which takes place. In this, as in several other of the operations mentioned above, retrograde catherization by means of a ureteral catheter will be found useful.

It should, of course, be borne in mind that in the past nephrotomy has often been the operation of choice for the relief of hydronephrosis. When nephrotomy is performed, however, and the sac opened, a urinary fistula results which may persist for months. To a great extent the operation of nephrotomy is being superseded for the relief of retained renal secretion by some of the methods mentioned above. Referring to these operations more in detail, a remark of Israel's may well be quoted here. He has well stated that for the relief of hydronephrosis it is necessary to remove the cause. In a large proportion of the operations for the relief of hydronephrosis, anchorage of the kidney in a proper position

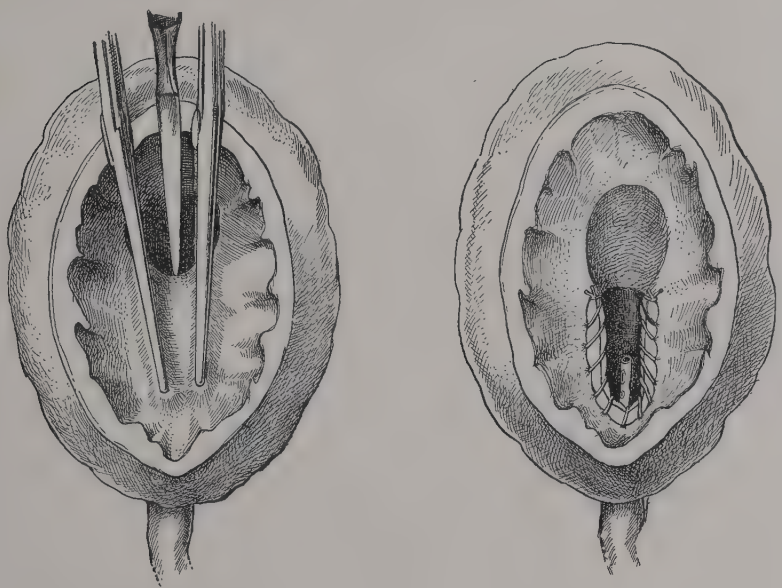


Fig. 123.—Operation for incision and suture of renal valve (redrawn from Pierre Duval).

is required. Rarely, although occasionally, it alone may suffice, but ordinarily it should be performed in connection with some other operation. Albarran considers[1] that the three most useful operations are those for the resection of the sac, of lateral anastomosis of the ureter, and pyeloplication, which is the operation of Israel.

[1] "Transactions in Urology," 1904.

In resection of the sac, the sac having been punctured and emptied, the clamp is placed as shown in the illustration (fig. 124), the sac is amputated, lumbar drainage is instituted, and a ureter catheter is allowed to remain. This operation was, we think, first performed by Albarran. The operation of lateral anastomosis is easily understood from the illustrations. The ureteral catheter in No. 11 acts as a splint for the new ureteral orifice, and is temporarily fastened in place by a thread emerging through the nephrotomy wound. In suturing the orifice, the second set of sutures are used to reinforce the first.

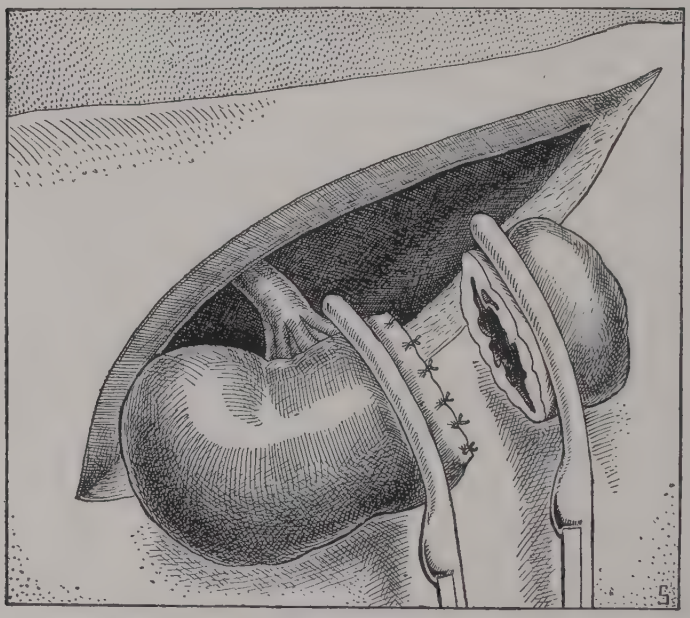


Fig. 124.—Operation for resection of hydronephrotic sac (redrawn from Pierre Duval).

The **operation of Israel** is as follows[1]:

The operation consists of the following steps:

(1) The occlusion of the pelvis of the kidney to such an extent that the origin of the ureter lies in the most dependent portion of the reservoir.

[1] James Israel, "Chirurgische Klinik der Nierenkrankheiten," May, 1901.

(2) The lessening of the volume of distended pelvic cavity of the kidney.

(3) The forcing down of the upturned neck of the ureter.

An incision is made into the posterior wall of the pelvis for exploration, and then sutured. Catgut sutures are then inserted into pelvis of the kidney, 1.5 cm. from the sutured exploratory

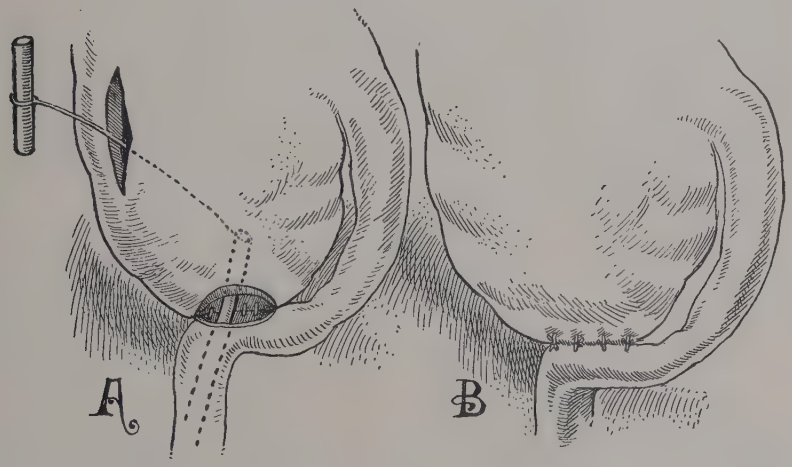


Fig. 125.—Operation for lateral anastomosis of ureter (redrawn from Pierre Duval).

incision, each being separated 5 mm. from the rest. All sutures pierce the walls of the pelvis of the kidney, diverging markedly. The suture is brought out 5 mm. from the exploratory incision, introduced again posterior to the exploratory incision 5 mm. away, and finally brought out at a point at the widest distance between the hilum of the kidney and outlet of pelvis. When these sutures are tied, the distended wall of the pelvis is no longer present, and the newly formed base of cavity is in a line from hilum of the kidney to the mouth of the ureter. If the neck of the ureter is turned upward, the following operation is done for its correction. A suture is introduced into the lower wall of the pelvis, 1 cm. above the angle of ureter, is carried for 5 mm. into its substance; it is reinserted below the point of angulation, and carried for several millimeters into the muscular wall, and then brought out. After tying this suture the ureter is then brought down to its proper position.

Class II.—The most frequent operations to be considered under this head are those ordinarily performed for those cases in which, as the result of injury, the lower opening of the ureter is transplanted into another portion of the bladder than that into which it originally opened. The ureter having been exposed by whatever seems the most desirable route for the case in hand, may

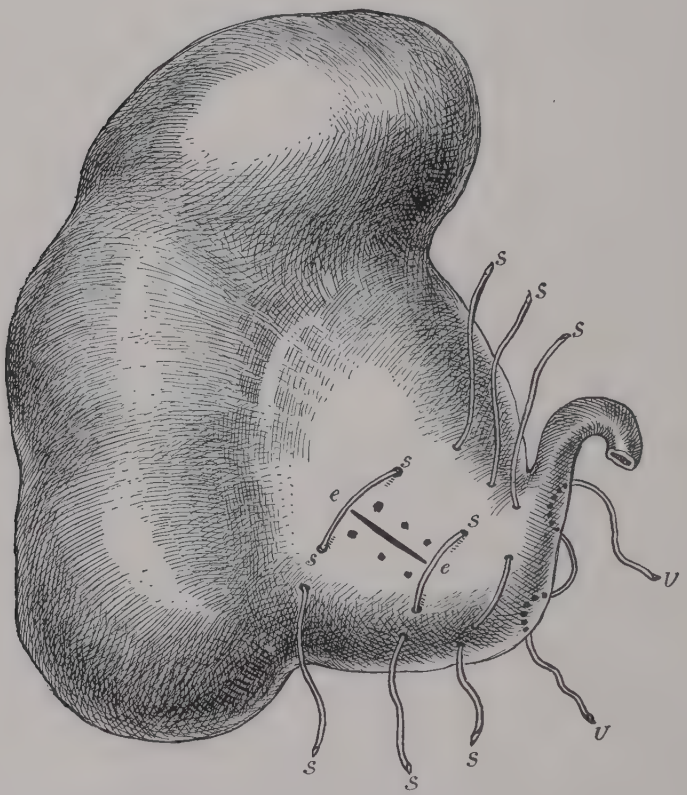


Fig. 126.—Pyeloplication and ureter correction. Posterior view of left kidney. *e*, Exploratory incision; *S*, *S*, sutures for the pyeloplication of the sac; *U*, suture to correct shape of ureter (redrawn from James Israel).

be made to enter the bladder at a right angle or in an oblique direction, as shown in the accompanying illustration (fig. 127). If it is made to enter in an oblique direction, it should be firmly fastened by sutures carried through the external bladder-wall, with-

out penetrating the inner coat of the bladder, for an inch, when possible, before the mouth of the ureter enters the bladder-cavity directly. The length of the adherence of the course of the ureter to the bladder tends to make the bladder act as a splint to the ureter and holds the latter in place.

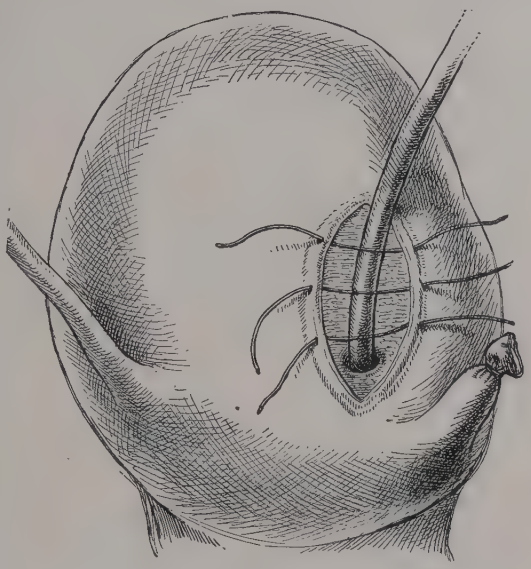


Fig. 127.—Showing oblique insertion of transplanted ureter into bladder (after Büdinger).

Operations have occasionally been made for the purpose of transplanting the mouth of the ureter to the skin, the vagina, rectum, and the urethra. Such operations are sometimes performed to give temporary relief after an operation for malignant disease.

The most common operative procedures coming in this class are those practised for the transplantation of the end of the ureter into another portion of the bladder, as just described, and the operation of transplanting the mouth of the ureter into the intestinal canal. At the present time, the anastomosis is most generally made into the rectum. Such anastomosis is ordinarily performed for the relief of exstrophy of the bladder. Carl Maydl was the first to suggest that, in performing such anastomosis, if a portion of the trigonum is removed with the mouth of the ureter, the contractile power of the ureter might remain unimpaired. This method has been modified somewhat by Carl Beck, of New York, and is described by him in an article entitled "Rectal Anastomosis of the Ureters."[1] He suggested that the flap assume a rhomboid instead of an elliptic shape, which would

[1] "New York Medical Journal," May 19, 1906.

permit it to be more easily attached to the longitudinal opening in the intestine.

It occasionally happens that unilateral implantation of the ureter into the rectum is indicated for conditions other than exstrophy of the bladder, as for the relief of destructive processes caused

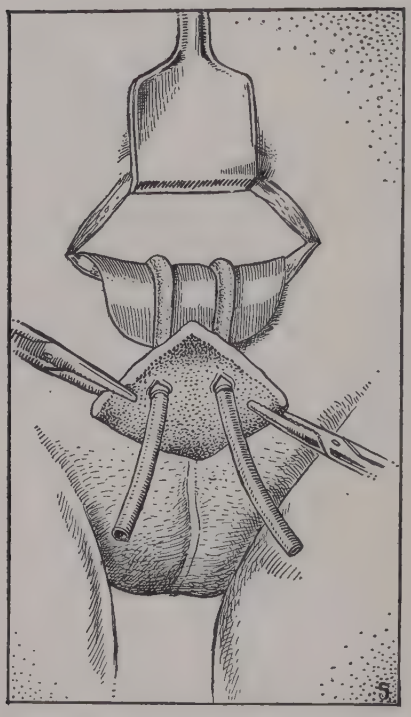


Fig. 128.—Vesical trigonum exsected after introducing catheters into the ureters (Beck).

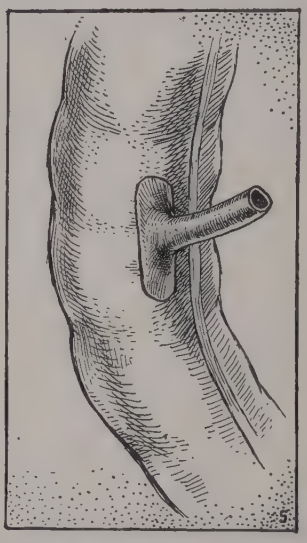


Fig. 129.—Lower end of ureter implanted into the bowel after being split (Beck).

by malignant disease, such as carcinoma of the bladder or ureteral fistula. In these cases, according to Beck, stenosis is best avoided by splitting the lower end of the ureter before placing it into the slit made in the bowel. The transplanting of the mouth of the ureter by making a slit into the bowel and removing the end of the ureter with a portion of the trigonum attached (fig. 128), or in unilateral cases by splitting the end of the ureter in the manner just described, is the method by which the ureter is invaginated into the wall of the bowel and sutured there (fig. 129),

and is probably preferable to any procedure that involves the insertion of a mechanic appliance.

Inflammation of the kidney, the result of an upward extension of infection, is often said to take place after anastomosis of the lower end of the ureter, but this result does not necessarily follow

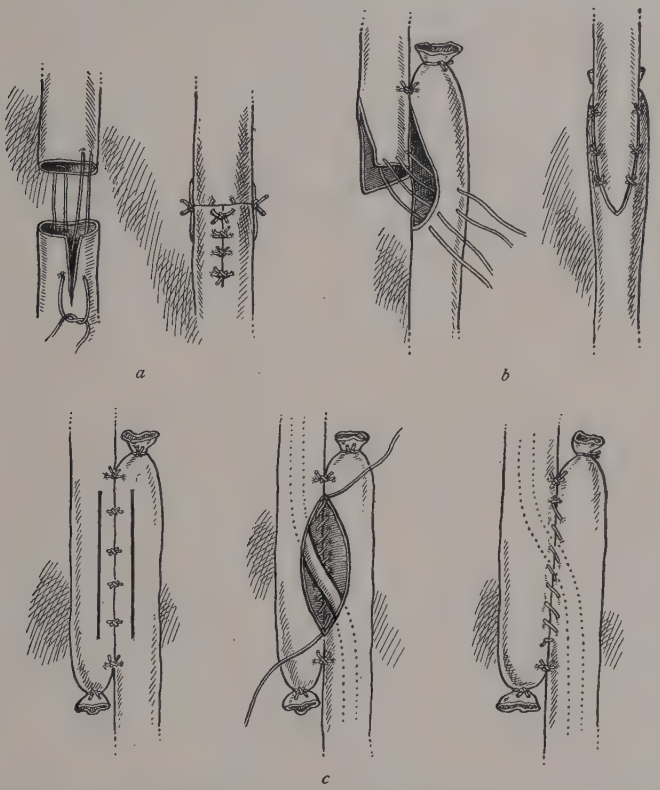


Fig. 130.—Various methods of ureteral anastomosis: *a*, End-to-end anastomosis of severed ureter; *b*, terminal lateral anastomosis; *c*, the three steps in the operation of lateral anastomosis (Pierre Duval).

in all cases. The statistics of Bouvée showed that in 1903 the operation of ureteral anastomosis was performed in 111 cases, with 7 deaths.

A study of the histories of the cases on record lead to the conclusion that the various anastomoses on the upper end of the ureter into some other portion of the pelvis of the kidney than it

originally occupied is often attended with failure. On the other hand, anastomosing of the lower end of the ureter to a different position in the bladder wall is very often successful, and the ureter functionates in a natural manner.

CLASS III.—**Operations for Wounds of the Ureter, for Removal of Stone, and for the Relief of Strictures of the Ureter.**—Wounds of the ureter may involve either extremity, but as they are made most often during gynecologic operations, they are most likely to be inflicted along the mid course of the ureter. Longitudinal wounds of the ureter have a tendency to heal spontaneously. The ureter having been exposed, as previously mentioned, a few sutures should be taken through the outer layers of the ureter, or a catheter be allowed to remain in the pelvis of

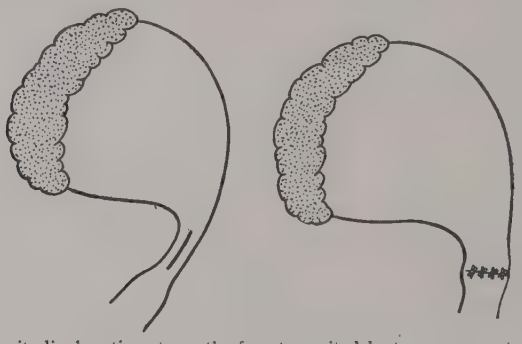


Fig. 131.—Longitudinal section at mouth of ureter united by transverse suture (Berger and Hartmann).

the kidney for a few days to act as a splint for the injured tube. When the wounds run in a transverse direction and the ureter has been completely severed, the procedure will be more difficult.

Various suggestions have been made by surgeons as to the best means of effecting union of the severed ends. Generally speaking, the same procedure is followed as in those cases in which the intestine has been completely severed. The two severed ends may be brought in apposition and sewed together, or one end be invaginated into the other. Incisions may be extended, made oblique, or the two ends may be zigzaged into each other, as the surgeon sees fit. The different methods of uniting the severed ends of the ureter are well shown in the illustrations accompanying the article (fig. 130).

For removing a stone from the ureter the longitudinal incision is the preferable one. Occasionally, operating through the bladder, a stone may be removed from the ureter by the finger or by the use of long narrow forceps if the mouth is, as occasionally happens, dilated.

In operating for the relief of stricture of the ureter, wherever

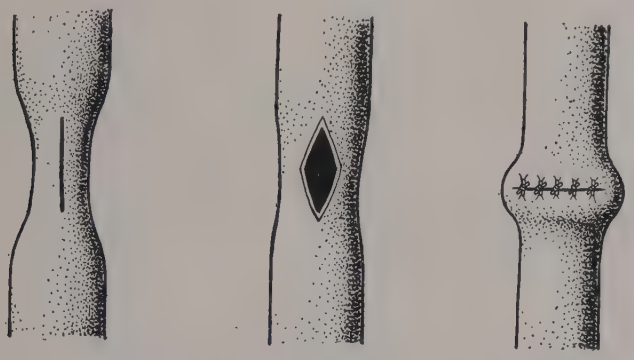


Fig. 132.—Method of incising and suturing stricture of ureter (Berger and Hartmann).

located, a longitudinal incision can be sewed up laterally, so as to extend the diameter of the ureter, as illustrated in the cut (fig. 132). This was suggested by Finger. Another method for the relief of stricture of the ureter is its gradual distention by the passage of sounds designed for that purpose.

Attempts have been made to remove the ureter completely when the tube was found to be markedly diseased. The term *ureterotomy* is applied to a simple incision in the ureter, whereas *ureterectomy* refers to total ablation of the ureter. Resection of the canal has been performed comparatively rarely. It is considered good practice, at the present time, in performing nephrectomy, to remove also large portions of the ureter when the tube is apparently diseased.

Such a condition as tumor of the pelvis of the kidney, according to Paul Wagner,[1] not infrequently has a ureter diseased at both ends, with healthy tissue between. When practical, in performing an exploratory operation on the kidney, or a nephrectomy, the opening of the ureter should be examined and

[1] Frisch and Zuckerkandl.

some instrument passed through its canal into the bladder. The lower end of it can, of course, be examined through the cystoscope, and now that ureteral catheterization is being performed so frequently, it is not only furnishing aid in the performance of many operations on the kidney and the ureter for the purposes of drainage and for diagnosis, but also in furnishing knowledge as to the condition of the ureter itself. The surgeon in performing ureterectomy will necessarily have to be guided by the conditions surrounding any given case. It is seldom necessary, in performing ureterectomy, to entirely remove the portion which enters the bladder. If such should be the case, a straight median incision is made in the posterior wall of the bladder, and a partial resection of the bladder performed.

CHAPTER XIX

ANATOMY, PHYSIOLOGY, AND PATHOLOGY OF THE BLADDER

ANATOMY AND PHYSIOLOGY

The bladder is a hollow viscus, lying in the anterior portion of the pelvis. It serves as a receptacle for the urine, which drains downward through the ureters, and retains it until it is finally voided through the urethra. The average bladder capacity is about one pint, but this varies considerably in proportion to the size of the body and according to the habits of the individual. The viscus is so constructed as to permit of a considerable degree of physiologic distention; and it may, under certain conditions, become enormously distended. When empty, it lies posterior to the pubic arch, its upper surface only being covered by the peritoneum; but when distended, its cavity lies above the arch, and the superior and posterior aspects become invested by peritoneum. Its summit is attached to the abdominal wall by a fetal cord or filament, the *urachus*. The bladder is supported by four true ligaments, all derived from the rectovesical pelvic fascia.

The bladder is made up of four coats, a serous or serofibrous, a muscular, a submucous, and a mucous.

The *serous coat* is derived from the peritoneum and is, as already mentioned, incomplete. It is moderately well supplied with blood-vessels and nerve-fibers. The *muscular coat* is made up entirely of smooth involuntary muscle. Diagrammatically it is divided into an external longitudinal, a middle circular, and an internal longitudinal layer; anatomically no distinction can be made between these layers, which are blended into one another and associated with numerous oblique fibers so that contraction of the bladder takes place in every direction. In the lower part of the circular layer, however, the fibers thicken distinctly around the urethral opening, just posterior to the prostate gland, where

they form a distinct muscle—the sphincter vesicæ. The *submucous coat* is made up of a dense layer of areolar connective tissue in which yellow elastic fibers occur in great abundance. This coat is highly vascular and contains many nerve trunks. The *mucous coat* of the bladder is made up of a thick layer of transitional epithelium, so arranged that when the bladder is collapsed, the cells pile up together; when distended, they glide over one another so that the entire surface is still invested by epithelium; in a greatly distended organ, therefore, the mucosa may be covered only by a layer of simple squamous epithelium.

The *blood-supply* of the bladder is derived from the superior and inferior vesical arteries and from branches of the hypogastric.

The *nerve-supply* of the bladder comes from the third and fourth lumbar and the second sacral spinal nerves and from branches of the hypogastric sympathetic plexus.

The function of the bladder is largely that of a passive reservoir into which the urine is ejected by the ureters. Its muscular contractions are, to a greater or less degree, under voluntary control, although dependent largely on the smooth muscle coat, which is innervated by the sympathetic nervous system. These movements are inaugurated and intensified by the voluntary contraction of the abdominal muscles. The external sphincter of the bladder seems also to be, at least to a considerable degree, under voluntary control. The contraction of the bladder is, however, undoubtedly inaugurated as a reflex act following stimulation of the sensory nerves of the urethra by the escape of a few drops of urine into it. The spinal center that controls the contractions of the bladder is probably situated between the second and fifth lumbar segments.

PATHOLOGY OF THE BLADDER

Congenital Malformations.—The most important of these abnormities assumes the form of *aplasia* or *exstrophy*. In this condition the anterior wall of the bladder and of the abdomen is defective and the posterior wall of the bladder, usually showing the urethral orifices, is exposed to the air. The condition is generally associated with epispadias, or with other congenital defects of development in this region. Cases of *permeable urachus*, in which

PLATE X

Cross-section through normal male pelvis.

the urine may be discharged through the umbilicus, are occasionally seen. The condition occurs most frequently when more or less atresia of the urethra exists. *Abnormities in the shape and size* of the bladder are not infrequently seen, usually at autopsy; they are anatomic curiosities and have but little clinical importance.

Acquired Malformations.—The most frequent acquired malformation of the bladder is a *chronic dilatation* that follows habitual overdistention of the viscus. This occurs, as a rule, as a result of obstruction to the urinary outflow, as from urethral stricture or hypertrophy of the middle lobe of the prostate. The condition is frequently associated with more or less ulceration of the mucous membrane, and with alkaline fermentation of the urine when infection has taken place. Dilatation of the bladder, when of long standing, is generally associated with thinning and atrophy of the muscular coat, and with more or less interstitial hyperplasia. In the early stages of the disease considerable hypertrophy of the muscular coats may take place, but this commonly terminates in muscular atrophy and fibrous replacement, with a greater or less degree of inflammatory change.

Vesical diverticula may form as a result of localized areas of muscular atrophy, such as may follow embolism of the nutrient vessels or fibrous proliferation occurring in inflammatory disease associated with overdistention.

Considerable *distortion of the bladder* may take place in the female in cases of vaginal cystocele or in either sex when the bladder is included in a hernial protrusion, or where foreign bodies are found in it.

Rupture of the bladder may occur as the result of either acute or chronic overdistention. It may arise spontaneously or follow infliction of a traumatism, oftentimes of very slight degree. It not uncommonly takes place in certain comatose conditions, as in alcoholism, in which overdistention of the bladder is associated with some injury. The writers have seen a case of vesical rupture follow the simple fall of an intoxicated man. The accident is much more likely to occur when ulceration or some other disease process has brought about a lowering of the resistance of the bladder-wall.

Perforations of the bladder permit the more or less rapid extravasation of urine into the surrounding tissues. They may be caused by stab or gunshot wounds, by direct or indirect traumatism, as in fracture of the pelvis, or as a result of ulceration or neoplasm of the bladder or adjacent viscera. A perforation into the peritoneal cavity is usually followed by a rapid and often fatal peritonitis, and when the puncture occurs in the lower quadrant, urinary extravasation into the pelvic structures and fascia takes place. This often results in the production of gangrenous inflammations or in the formation of vesicorectal or vaginal fistulæ.

Atony of the Bladder.—Weakness of the muscles of the bladder-wall is usually due to overdistention. It may be due to a natural atrophy of the muscular tissues, which normally occurs in old people, and which has been so carefully investigated by Chiencanowski, in a work already referred to by us, who found in old people only about two-thirds of the normal amount of muscular tissue was apt to be present. It may be due to a disease of the nervous system, such as neurasthenia, and it may follow conditions giving rise to exhaustion, such as various forms of fevers. It is frequently found allied with such conditions as urinary obstruction or cystitis. It is more often seen in women than in men, not infrequently following such a condition as pregnancy. It is occasionally seen after influenza as a sequela to this disease. It is characterized generally by overdistention and very much diminished expulsive power in the passage of the urine.

Diagnosis.—A history of the case, the slowness of passage of urine, even if bladder is catheterized, and the presence of overdistention. Patients generally pass little urine with this condition, and that voided is apparently an overflow, and is liable to mislead the medical attendant as to the condition present unless the catheter is used. When percussion and palpation of the abdomen show fullness over the bladder region, it is generally advisable to use a catheter to aid in the diagnosis rather than to be misled through trusting too much to the history of any given case.

Treatment.—The treatment necessarily, to a considerable extent, consists in treatment of the underlying causative factors,

such as of any cystitis that may be present, or that directed toward the relief of the urinary obstruction. The internal administration of certain nerve tonics, unless their use is otherwise counterindicated, is beneficial. The following prescription is useful:

Tincture of nux vomica..... 2 drams
Tincture of cantharides..... 1 dram
Compound tincture of cinchona to make 4 ounces.
Sig.—One dram three times daily, in water, before meals.

As regards local measures, the most useful is vibratory massage applied by the hand on the abdomen over the bladder region. The use of static electricity, both to the spine and over the abdomen, may be attended with good results. In these cases the utmost regularity should be observed as to emptying the bladder at certain specified times.

Incontinence of Urine in Children.—Incontinence of urine in children generally occurs at night. It is often associated with organic disease of the urinary tract, but it is usually due to insufficient innervation of the compressor urethræ muscle. The treatment of this condition is both general and local. Internally, belladonna and strychnin are the two most popular remedies; the administration of these drugs, however, is not always followed by relief. Locally, faradization of the suprapubic region and the perineum has often been recommended. Massage, similar to massage of the prostate in the region of the seminal vesicles, has been highly lauded by a German specialist. It is recommended also that care be used to avoid pressure of the bed-clothing on the bladder region, and habits of emptying the bladder at regular intervals should be formed. In every case the child should fully empty the bladder before going to bed, and the amount of fluid taken during the afternoon and evening should be restricted. Mental control should be inculcated, and all local irritations, as from vulvitis or proctitis, relieved.

The writers' experience with this class of cases seems to show that, if examined carefully, some abnormal condition of the general system will be found, which, if cured, will usually result in relief of the incontinence. Thus a considerable number of cases are relieved or cured by circumcision or by successful treatment of a urethritis. An examination of the blood will frequently

reveal the presence of anemia or malaria, which may act as predisposing causes.

These or similar existing conditions should receive appropriate treatment, associated with measures that tend to improve the general health, such as cold sponge-baths. The internal administration of nerve tonics, such as the phosphates, has, in the writers' experience, given excellent results. Raising the foot of the bed so as to keep the urine away as much as possible from the neck of the bladder is generally of benefit.

Cystitis.—Inflammation of the bladder, or cystitis, may be a limited, localized process, affecting only a small area of the bladder surface, or it may be a generalized process that involves the entire mucous membrane. Cystitis is most frequently caused by the presence of infectious micro-organisms, although traumatic cystitis is by no means unknown; even in the latter instance, bacteria that subsequently enter usually play an important rôle. The disease generally arises as the result of infection extending inward from the urethra; when, alkaline decomposition of the urine occurs, it acts as an additional etiologic factor. Cystitis is frequently induced by careless instrumentation, as a result of which bacteria are directly introduced into the bladder cavity, or some injury inflicted on its mucous membrane that may first cause a mechanic and not an infectious process to manifest itself.

Following injuries to the mucous membrane of the bladder it should be remembered that bacteria, often of a pathogenic variety, are excreted normally in the urine. Under healthy conditions these give rise to no disturbance; but in the presence of an abraded mucous membrane, infection and cystitis are very likely to develop.

A certain number of cases of cystitis occur in consequence of infection extending downward from the kidney. This is particularly true of certain instances of renal tuberculosis and pyonephrosis.

The disease occurs very commonly as a result of the presence of foreign bodies in the bladder. These may be particles introduced from without, or, in many cases, are stones formed either in the kidney or in the bladder itself. Infection with more or less urinary

decomposition is practically certain to develop in nearly all such cases.

Simple catarrhal inflammation of the bladder is a much more prevalent condition than is generally supposed. It most commonly arises as the result of inflammation set up by a urine that possesses irritating chemic or physical characteristics. This occurs in such conditions as oxaluria, in high concentration of the urine, or when acid phosphates are present in excessive amounts. Catarrhal cystitis is also an uncommon accompaniment of the acute exanthemata.

The pathologic lesions present in cystitis vary more in degree than in character according to the etiologic factor in each particular instance. The simple catarrhal condition is manifested by congestion of the blood-vessels, swelling of the mucous membrane, and usually more or less desquamation of the epithelium. Leukocytes and pus-cells appear in small numbers, and unless the condition is of long standing, the other coats of the bladder present little, if any, change.

Purulent cystitis may follow as a direct result of the catarrhal disease or it may develop independently. In this form of cystitis marked erosion of the bladder epithelium takes place; the blood-vessels of the submucosa become intensely hyperemic, and there is an abundant exudation of pus-cells, extending not only through the mucosa into the cavity of the bladder, but also into the submucous and muscular coats. Ulceration develops sooner or later, and is generally associated with alkaline fermentation of the urine, so that a precipitate of triple phosphates and other urinary salts is deposited on the inflamed and eroded mucous surface. In long-standing or active cases the ulceration may extend from the submucosa into the muscle-walls; hyperplasia of connective tissue almost invariably follows, and results in muscular atrophy and marked fibrous thickening of the bladder-wall. This thickening is directly associated with greatly impaired muscular force and diminished elasticity of the bladder-walls. Even when healing takes place and the mucous membrane is completely covered with newly formed epithelium, the interstitial hyperplasia in the muscle coat may have been so great as to preclude the restoration of proper muscular control of the bladder.

Phlegmonous cystitis occurs in very active and virulent infections, or in those cases in which trophic disorders are associated with overdistention, as is well exemplified in many spinal lesions. Usually when active gangrenous destruction of the bladder-wall takes place, if the patient survives long enough perforation results.

Tubercular cystitis is by no means a rare condition. As a rule, it is secondary to tubercular disease of the seminal vesicles, prostate, or urethra or to renal tuberculosis. It must be remembered, however, that purely tubercular infections of the kidney do not tend to set up tubercular cystitis unless mixed infection occurs, or some mechanic factor, as overdistention or instrumentation, acts as a predisposing cause.

The pathologic changes in tubercular cystitis differ but little from those seen in the other forms of cystitis, except that tubercles occur. The tubercular ulcerations are usually not sufficiently characteristic to justify an absolute diagnosis from their gross appearance alone. This is doubtless due to the fact that mixed infection almost invariably takes place and the lesions no longer remain of a characteristically specific type. Inspection with the cystoscope is, however, of great diagnostic assistance, and at times may be conclusively final. Where tubercular cystitis is suspected, one should carefully search for other tubercular lesions elsewhere and a bacteriologic examination of the urine should be always made.

Acute syphilitic disease of the bladder is infrequent. When it exists, it is so closely associated with mixed infections as to render its diagnosis in local lesions impossible, but the contracted bladder common in old cases of syphilis is a frequent and important condition.

Tumors of the Bladder.—The study of this subject has received a new impetus on account of the greater facility with which the condition may now be diagnosticated while still in a stage affording some hope for favorable results of treatment. At the same time the use of the operating cystoscope, and of other modern surgical methods, has placed in the operable class many neoplastic lesions of the bladder which up to very recent times were considered absolutely hopeless. The recent publications of Watson, Mandelbaum, and others in America, and those of Albarran,

Frisch, Zuckerkandl, and Stoerk abroad have reopened the entire question in an entirely new light.

Growths of the bladder have, nevertheless, been found as a rare condition in our personal experience, both clinical and post-mortem, but the growing importance of the subject is now such as to demand more than passing attention.

Neoplasms of the bladder may, for clinical purposes, be best discussed as innocent and malignant and as primary or secondary. True metastatic tumors, as pointed out by Mandelbaum,[1] are unusual.

Innocent Tumors.—Innocent tumors of the bladder, of course, occur only as primary growths, except where virtual invasion of the bladder may result from the extension of an adjacent tumor so that compression of the bladder follows. As an example, one might cite osteomata or chondroma springing from the pelvic girdle.

Papilloma is unquestionably the most frequent and most important innocent tumor of the bladder. It is composed of an elementary villus of connective tissue which originates from the submucosa of the viscus, growing inward and investing itself with a sheet of epithelium which in most cases retains the general character of the transitional epithelium of the cystic mucosa. In some cases, however, the epithelial coat is made up of simple or stratified columnar epithelium. As a rule, these growths are pediculated, though occasionally one finds sessile masses of this variety. They are generally highly vascular, the blood-vessels being supported by the scanty connective-tissue framework; they, therefore, bleed readily when injured. The tumor commonly originates as a small and slowly growing excrescence, generally situated near the trigone, but if not promptly removed, they are very prone to extend rapidly and may eventually involve the entire surface of the bladder, as shown in Plate XI. As a result of the villous nature of the growth, crystals and deposits of urinary salts are very likely to take place about them and may so cause relatively early disturbance of a recognizable nature. Undoubtedly, bits of these tumors so detached oftentimes form the nucleus of stone formation.

[1] "Surgery, Gynecology, and Obstetrics," Sept., 1907, p. 315.

Papillomata show a well-recognized tendency to return, even after apparently complete removal, and for this reason we advocate the more active methods of surgical treatment, even in the early stages, for this variety of tumor. Furthermore, there is no question but that they may eventually become the seat of malignant alterations which form the nidus of cancer formation. The diagnosis is usually easy, fortunately, because of the characteristic gross appearance with the cystoscope and also since the growth ordinarily causes a good deal of irritation, which attracts the patient's attention to the bladder. Occasionally bits of the villi may become detached and swept off in the urine, appearing in such condition as to permit of microscopic examination and absolute diagnosis.

Fibroma.—This tumor is found but very rarely, and is seen mostly in the neighborhood of the trigone. It is found developing in the submucosa or from the muscle coats, and ordinarily is covered over by the mucous membrane, which does not become attached to the growth except as a result of secondary inflammation. The tumors are generally of small size, and the only cases which have appeared in the experience of the authors have been associated with general fibromatosis.

Myxomata of the bladder are also infrequent, and develop in much the same location and way as the fibroma. They are more apt to grow to tumors of considerable size, and in most cases are closely allied to myxosarcoma.

Myomata of the bladder have been observed, but the authors have never seen a case. They are reported as of the smooth muscle variety, and develop within the muscular or fibrous coats of the organ.

The **malignant tumors** of the bladder are reported with greatly variable frequency by various observers, largely since some include among the malignant growths most, if not all, the papillomata and some the myxomata as well. As we have pointed out, the papillomata are no more to be considered as primarily malignant in the bladder cavity than they are when they occur as primary growths, for example, on the skin or genital mucosa. None the less the frequency with which papillomata become malignant should be always borne in mind.

In our experience by far the larger number of primary malignant tumors of the bladder have been secondary and not primary in

Diffuse papillomata of bladder. (From a specimen in the Carnegie Laboratory Museum.) Every portion of the bladder mucosa was studded with villous projections. *a*, Papillomata projecting from mucous membrane; *b*, ureters; *c*, caput gallinaginis; *d*, lateral lobes of prostate.

the bladder. As stated by some authors, metastatic tumors of the bladder are relatively infrequent, but the organ is especially prone to become involved by extension from tumors of the uterus, Fallopian tubes, ovary, vagina, and notably from primary tumors of the prostate gland, a fact to which we have called especial attention in a previous publication. The importance of this observation is self-evident since, where the growth is but an extension from tumors primary in other tissues, but little more than temporary and palliative results are to be expected as a result of treatment of the bladder growth alone.

In regard to the primary malignant growths of the bladder, Mandelbaum makes the important statement that, as a rule, they remain more or less localized for comparatively long periods, and, therefore, operative measures of a vigorous nature are more justified than in instances where early general metastasis is prone to follow.

Cancer.—Carcinoma is undoubtedly the most frequent of the malignant new-growths of the bladder. As we have already indicated, the tumor is, in our experience, usually secondary and not primary, and this is especially so where a primary focus is located in the prostate. Primary cancer of the bladder, in our opinion, originates most frequently as a result of malignant transformation of a papilloma, hence the histologic variety, in a considerable percentage of the cases, is that of a papillary carcinoma. Adenocarcinoma also appears, and is found most commonly about the trigone, where a possible genetic relationship to the elementary glands located here seems probable. Epithelioma springing from the vesical mucosa is also found: it is usually of a somewhat less active course than the papillary and adenomatous types of cancer, which are found to be the most actively malignant. A relationship between the development of epithelioma and the irritation of a cystic calculus seems to be definitely established in some cases. Epithelioma and scirrhous carcinoma as well are found to develop in the edges of old ulcerations of the bladder. In such instances, unless the ulcer is kept under frequent inspection, the malignant transformation is apt to be insidious and unexpected. This affords a good argument for radical treatment, particularly in resistant cases of chronic ulcerative cystitis, especially those occurring after the fortieth year.

Perforation of the bladder wall and extension of the growth to adjacent structures are frequent in bladder cancer—rather less so in certain special forms, as in the scirrhous type, than in others, notably with the adenomatous and papillomatous forms. In practically all cases, oftentimes in the early stages of malignant neoplasm of the bladder, a cystitis develops, and this possible relationship to malignant disease should be considered in all cases where an idiopathic cystitis has developed. Where metastases take place, they are seen first in the pelvic lymph-nodes, as a rule.

Sarcoma.—This form of malignant tumor is seen rarely except as a result of extension of growth from the surrounding structures. No case of primary sarcoma has appeared in the writers' personal experience, and where metastatic sarcoma is present, it is most difficult to determine anatomically if the primary site be in the bladder or elsewhere. Except where material for microscopic diagnosis can be obtained, or where the growth is secondary in nature, differential diagnosis from cancer is very difficult and is relatively unimportant, since the methods of treatment are the same in both instances and the prognosis does not differ materially.

The more rare malignant tumors of the bladder, such as endothelioma, teratoma, and hypernephroma, do not demand special attention here, both because of their great infrequency and because the methods of management are identical with those in the conditions already considered. It is very probable that metastatic hypernephroma is not so very infrequent (two cases have been seen by the writers), on account of the marked tendency of this tumor to metastasize in the genito-urinary organs.

Syphilis of the bladder, to which reference is made in the earlier part of this volume in connection with the cystoscopy pictures, is being found with increasing frequency, owing to the greater familiarity with the cystoscope and the larger number of blood examinations being made for the Spirochæta. Its most prominent clinical symptom is that of intermittent hemorrhage; it may give rise to ulcers either single or multiple, yellow or purulent, deep or superficial. Sometimes, according to Gayet et Favre, they are polycystic, the general appearance resembling syphilitic ulcers in other portions of the body. They may also resemble sessile or pediculated tumors if they are gumma. This is referred to again in the subject of Treatment of Bladder Tumors.

CHAPTER XX

DIAGNOSIS AND TREATMENT OF DISEASES OF THE BLADDER

The necessity of first making a correct diagnosis in the treatment of bladder diseases cannot be too strongly dwelt upon. Clinical experience has served but to strengthen the opinion that carelessness in this regard is all too common, mistakes as to the nature of the existing condition, as well as to the causative factors, being frequently made. Not alone isolated, but whole series of cases are constantly being brought to our attention in which the seat of the trouble is primarily in the spinal cord, and the cystitis followed as the result of some nervous disorder and was confounded with primary cystitis. This mistake often occurs from an inability on the part of the practitioner to recognize and properly diagnose lesions of the nervous system. Locomotor ataxia, myelitis, and various other degenerative changes in the spinal cord are important and frequent factors in causing bladder disturbance. Then, too, there are seen cases of bladder disease due to muscular weakness—either weakness of the abdominal muscles or, in the aged, a weakness due to atrophy of the muscles in the bladder-wall itself, as was shown by the very interesting work of Cienchanowski. It is evident, in these conditions, that beyond local treatment, which should ordinarily, in these cases, be of the mildest character, the indications are to conserve and increase, so far as possible, the activity of the muscle. At the same time, by the use of baths, massage, a well-selected diet, and suitable internal medication, pathologic conditions of the spinal cord or of other portions of the nervous system may be improved or held in abeyance.

Another factor that is very often concerned as a cause of chronic inflammatory conditions of the bladder is late syphilis. The conditions to which we refer to are more often found in old syphilitics.

CYSTITIS

Acute Cystitis.—For clinical purposes cystitis may be classified as acute and chronic. Acute cystitis is rarely found existing alone or as a primary condition, being almost always secondary to or accompanied by acute inflammatory affections of other portions of the urinary tract.

Symptoms.—The most prominent symptom in acute cystitis is painful urination, accompanied by pain and distress referred to the lower portion of the abdomen. The urine is highly colored, occasionally tinged with blood, and contains pus, mucus, desquamated cells, and occasionally necrotic tissue from the superficial layers of the bladder. Rigors or chilly sensations generally occur, and there is usually a rise in temperature.

Diagnosis.—As referred to in the section on Examination of Patients, in making the diagnosis it is necessary to exclude acute urethritis, stricture of the urethra, prostatic obstructions from below and attacks of gravel from above, or disease of the nervous system when these conditions do not accompany the disorder. After carefully washing out the urethra as far as the compressor urethræ muscle, if, on urination into two glasses, the fluid in both glasses is found to contain pus, it is very positive proof that cystitis or some inflammation further up the canal is present. From stricture of the urethra it may be differentiated by the appropriate methods, which will be described in the diagnosis of stricture, and it may be differentiated from prostatic obstructions by a careful rectal and bimanual examination of the prostate. It is apparently an easy matter to make a diagnosis between cystitis and difficult urination due to urinary obstruction caused by an enlarged prostate; mistakes are, however, frequently made, and in doubtful cases a very careful examination is often necessary. In many cases of simple cystitis the ability to empty the bladder completely or in part still remains.

Gonorrheal cystitis in its clinical symptoms is similar to other forms of the acute variety, except that it is, as a rule, more severe in degree and more frequently attended with difficulty in micturition.

Treatment of Acute Cystitis.—The indications in acute cystitis

are to render the urine as unirritating as possible to the inflamed bladder-wall, to relieve spasms and pain, and to administer such remedies as tend to allay irritation of the mucous membrane. Rest in bed and a diet consisting largely or entirely of milk in some form is to be prescribed. For the relief of spasm warm applications to the lower part of the abdomen, hot sitz-baths, or, better still, when possible, partial immersion in a bath-tub above the waist, and urination under the water, will be found of benefit. Internally, small doses of spiritus ætheris nitrosi and salol, repeated four or five times during the day, are advisable. The old-fashioned infusions of buchu and uva ursi still have their advocates. The writers occasionally prescribe an infusion consisting of equal parts of flaxseed and elder flower flavored with licorice root; a small handful of the mixture is steeped for five minutes in a pint of water, and this is taken two or three times during the day. The infusion of dried violet flowers, as recommended in the treatment of Bright's disease, by stimulating the activity of the skin and thus relieving the kidney, indirectly benefits the bladder or one of the infusions mentioned in the treatment of chronic cystitis should be tried. Very rarely is the use of an opiate required in cystitis to relieve pain. When this is demanded, a rectal suppository of opium should be preferably given.

In the local treatment of acute cystitis, when not due to or associated with an enlarged prostate or with stricture of the urethra, the use of the catheter is but rarely required, but its employment may be followed by relief, and in certain cases, especially those of gonorrheal origin, when the patient is unable to urinate, its use may be imperative. Even in severe cases, however, hot sitz-baths may relieve the congestion at the neck of the bladder, and the power to urinate, which was temporarily lost, be regained after an hour or two. In cases of acute cystitis the smallest catheter practicable should be employed; and in lavage of the bladder, which is often done in conjunction with catheterization, only unirritating preparations should be used. Solutions of boric acid or of mercury bichlorid, 1: 10,000, with a drop of phenol to the ounce, or mercury and phenol combined in a saturated solution of boric acid make a useful fluid for the purpose, or mercury oxycyanid, 1 : 4000, may be employed. Later, as the patient improves, daily or triweekly lavage with silver nitrate, 1 : 10,000,

may be used. Internally, as the acute symptoms subside, oil of sandalwood may be administered. Fluidextract of kava-kava, in dram doses, repeated three or four times a day, or sandalwood oil and kava-kava combined, may be prescribed. Small doses of quinin are frequently needed from the onset, but very large doses of quinin tend to increase the congestion in inflammatory conditions of the bladder. The use of the salol, if introduced, should be continued for some time.

Chronic Cystitis.—*Diagnosis.*—In the diagnosis of chronic cystitis the same steps are to be followed as are taken in making the diagnosis of acute cystitis, which it often follows. The cystoscope is coming more and more to be recognized as useful for this purpose. In a large proportion of the cases of chronic cystitis the inflammation will be found, on cystoscopic examination, to be confined to the lower portion of the bladder—very rarely, indeed, is the vault of the viscus invaded. A varicose condition of the veins at the base is often found, and the general appearance described in the section on the Pathology of Cystitis is seen. Attention must be called, however, to the difficulties that may be encountered in making an accurate diagnosis from cystoscopic observation unless the examiner is familiar with the appearance of the normal bladder.

Treatment of Chronic Cystitis.—Patients suffering from chronic cystitis are generally able to be up and about, and in some cases are benefited by exercise in the open air. For those of a robust constitution, such exercises as swimming are sometimes of value in hastening the convalescence from all chronic inflammatory conditions of the bladder and urinary tract. A careful but not necessarily a restricted diet, avoiding especially asparagus, cabbage, cauliflower, rhubarb, or highly seasoned foods and all irritating condiments, is to be advised. The general health of the patient should receive attention, and suitable tonics should be prescribed. If blood examination shows the presence of malarial plasmodia or the existence of anemia, proper corrective measures should be instituted.

The *internal treatment* of chronic cystitis differs somewhat from that of the acute type. Iron in an unirritating form, arsenic, and quinin may be advantageously administered. The

various balsamics may be employed with benefit, either alone or in combination, and used in conjunction with the infusions previously suggested as serviceable in the treatment of acute cystitis. Fluidextract of kava kava in dram doses, several times a day, may be used with benefit.

Such good results have attended the use of certain infusions in our experience that we give here some formulas for the same which were omitted in previous editions of this work, the use of which will be found beneficial. For cystitis, acute and chronic, the following is recommended:

Corn silk ..... ½ ounce;
Flaxseed ..... 1 ounce;
2 drams for a cup of infusion.

Buchu leaves ..... ½ ounce;
Peppermint ..... 2 drams;
Sugar (q. s. to sweeten);
2 drams to cup of boiling water three times a day.

Uva ursi ..... ½ ounce;
Cherry stems ..... 2 drams;
Flaxseed ..... ½ ounce;
2 drams to cup of boiling water three times a day.

The following has a somewhat more diuretic and stimulating action:

Cubeb berries, bruised,
Juniper berries, bruised ..... each ½ ounce.
Two teaspoonfuls to cup of boiling water three times a day.

As a diuretic:

Couch grass,
Cut licorice root ..... each ½ ounce;
Marshmallow leaves,
Elder flowers ..... each 2 drams;
4 drams to a tea cup of boiling water three times a day.

Local Treatment.—The local treatment is of great importance in this condition. Silver nitrate is the most useful of the local applications. The bladder should be filled with from four to eight ounces of a very weak solution of silver nitrate—not stronger than 1: 10,000 to begin with. If this is well borne, the strength may gradually be increased to 1: 5000. Silver nitrate is very commonly prescribed in solutions of too great strength. These irrigations of the bladder should be made from two to four times

a week. The silver nitrate irrigation should not be followed by one of boric acid, as a chemic change will take place between the two solutions, rendering both inert. If the bladder does not react well to silver nitrate, the solution next in favor with the writers is the old Ultzmann mixture of zinc sulphate, phenol, and alum, of each from 1 : 1000 to 1 : 500. A few applications of this will frequently so far improve the condition as to permit the silver nitrate irrigation, which previously proved too irritating, to be used. Of the newer remedies, probably albargin, in the strength of 1 : 5000, or mercury oxycyanid solution, 1 : 5000 or 1 : 2000, will give good results.

In certain cases of chronic cystitis the following combination has been recommended for bladder irrigations: Tincture of iodin, one part, potassium iodid, one part, extract of belladonna, one part, water, 300 parts; or, if preferred, the belladonna may be omitted, and the amount of tincture of iodin be increased up to two or three parts.

Potassium permanganate in very weak solutions is also useful.

A large number of cases of cystitis of the chronic type may be divided into two classes: (1) those with overdistended bladder; (2) those with contracted bladder. Overdistention is the most common cause of bladder disease. In such cases, if the mucous membrane is, in addition, chronically inflamed, a large quantity of fluid may be used in irrigation without giving rise to pain. These cases of overdistention with cystitis are often associated with enlarged prostate or urethral stricture. The other class, those with a contracted bladder, are usually cases of pure cystitis. In these, there may be no urethral lesion or prostatic obstruction. When irrigations are used in such cases care must be observed that too large an amount of fluid is not used. Sometimes the bladders of such patients retain with comfort only from two to four ounces of either urine or any irrigating fluid. Although not to be recommended for routine procedure, good results have been obtained in such cases by irrigations, say, of from two to four ounces of weak silver nitrate solution, increasing the amount of each irrigation by 60 to 90 drops over the preceding one. The frequency with which syphilis is the cause of chronic cystitis of the second type—that with a contracted

bladder—should be borne in mind, and it is not amiss in these cases to try the effects of mixed treatment.

In non-tubercular cases, when other measures fail to bring relief, a perineal section may be made, a tube introduced, and the bladder allowed to drain for a week; thus affording rest to the bladder-wall and diminishing the congestion of the mucous membrane. Continuous irrigation of the bladder for a few days with an unirritating solution, applied through a double-current catheter passed through a suprapubic opening has shown good results as a method of treatment in certain cases of severe cystitis. We think this procedure may in the future occasionally prove a helpful one.

Tubercular Cystitis.—Tubercular cystitis almost never occurs as a primary disease, but results as an extension downward of the infection from a tuberculosis of the kidney, or it occurs as an ascending infection from portions of the tract lower down, such as from the urethra or prostate (*vide supra*). In its late stages it is diagnosed with comparative ease, and is accompanied by such symptoms as painful and frequent micturition, pus in the urine, and more or less pain over the bladder region. In the earlier stages the diagnosis is made with more difficulty, for there may be only a slight amount of burning on urination, and the urine may show so little pus as to appear only on microscopic examination. In patients with pulmonary tuberculosis, however, even such mild urinary symptoms should lead to a suspicion of tubercular cystitis, particularly if there has been no history of previous urethral infection. Occasionally a history of repeated urethral infections and of many forms of treatment having been tried will be given, extending over a period of many months or years, with a gradually decreasing reaction to treatment, either local or general. These symptoms, if associated with marked physical depression, even if there is no evidence of pulmonary tuberculosis, should arouse a suspicion in the mind of the observer of beginning tuberculosis, either primarily or secondarily associated with the bladder. Those cases of cystitis that react poorly to almost all ordinary forms of treatment, either general or local, have not infrequently a tuberculous element, either pure or mingled with some other infection, such as gonorrhea. Statistical investigation tends to show that gonor-

rheal infection is one of the most frequent predisposing causes of tubercular infection.

By means of an air cystoscope ulcerations may be painted; one of the writers' associates recently applied phenol and iodin through an air cystosocpe to vesical ulcers of a tubercular character, but with negative results. It is to be hoped that in the future increased experience of surgeons with the effect of the direct application of local remedies will be productive of good results.

Even in cases of contracted bladder, if the bladder will hold 150 c.c., which is not enough, ordinarily, to permit ureter catheterization, cystoscopy may still be employed.

A rough but sometimes helpful method of diagnosing tuberculosis of the bladder is that of observing whether or not the bladder is intolerant to irrigations of silver nitrate of the weakest character even of a strength of 1 : 10,000. Many observers have noticed that in tubercular cystitis silver nitrate applications are badly borne. This intolerance to silver nitrate, to be sure, is not found wholly in the tubercular; those patients of neurotic tendencies sometimes show marked intolerance to the drug, and occasionally a constitutional idiosyncrasy against it exists. Many foreign as well as American writers have recommended irrigations of silver nitrate in strengths of from 1 : 500 to 1 : 50; this is too strong. For irrigating either the bladder or the deep urethra in tubercular or non-tubercular cases it is seldom advisable to use stronger irrigations than 1 : 5000. Locally, for irrigating purposes, solutions of mercury bichlorid 1 : 10,000, may be used. Iodoform also seems to be most popular among the local applications for the relief of the condition. It is generally used suspended in oil or liquid vaselin. In our hands for the local treatment of tubercular cystitis nothing has given as good result as ichthyol in very weak solution, of a strength of from one to two to one to four thousand or even weaker. It was somewhat by accident that one of us discovered the value of these irrigations, which in the first case in which they were used gave more relief than several other preparations previously used in the form of irrigations or instillations, and gave more relief than when the bladder was left untreated and general hygienic measures alone were depended upon. Some

further experience with its use in cases of tubercular cystitis have tended to confirm our belief in its value, and we commend ichthyol to the profession for the relief of this distressing condition.

In many cases of tubercular cystitis, general treatment, consisting of life in the open air, together with the internal administration of appropriate remedies, such as creasote, can best be relied upon to relieve the bladder condition.

One of the great difficulties that confronts the practitioner in treating tuberculosis of the bladder is to decide whether a given tubercular ulceration is due to a tubercular kidney or not, as the existence of the latter may often be suspected in these cases when it cannot be clearly demonstrated to be present. As the investigations of the whole matter of tuberculosis of the genito-urinary system are carried on with more thoroughness, tuberculosis of the kidney is found with increasing frequency.

Tubercle bacilli are found, according to Joseph Walsh, in 75 per cent. of the urines of fatal cases of pulmonary tuberculosis.

Since tuberculosis of the kidney is present in the vast majority of cases of tuberculosis of the bladder, and since in most cases of renal tuberculosis the infection is most marked in one kidney, the question arises, should the most diseased kidney be enucleated in the hope that this step will aid in the cure of the cystic tuberculosis. Apparently removal of the kidney aids in the cure of the cystitis in quite a proportion of cases, particularly if associated with the usual methods of general tubercular treatment. In all cases the general system, as a whole, should be fortified as much as possible by a large food-supply and the greatest amount of fresh air obtainable. Urinary antiseptics, such as urotropin and salol, may be used, nor in spite of the fact that the kidney is known to be diseased should local treatment of the bladder be entirely neglected, but, realizing that the bladder is ulcerated, greater care than ever should be taken in the introduction of all instruments. All local measures used should first be tentatively essayed, and modified as circumstances seem to indicate. In irrigation small quantities of fluid should

be used, as the bladder is frequently contracted—one should commence with not over four ounces.

Bazy advocates that, in cases where some mild preliminary local irrigation has been used, the bladder be emptied and the following remedy injected:

Iodoform (pulverized)	1 gram
Vaselin (liquid sterilized)	20 grams.

He recommends that the patient refrain from micturating as long as possible after the injection, and that urination be suspended on the first appearance of oil in the urine. In other words, the patient should not completely empty the bladder. His theory is that the iodoform will sink to the bottom of the bladder, where ulcers are most likely to be located, will serve as a coating for them, and, if the bladder is not completely emptied on urination, such a coating may remain for several days. Some patients retain a portion of the vaselin for from three to fifteen days, at the end of which time another similar application may be made. Iodoform may also be administered in the following combination:

Iodoform	1 gram
Liquid guaiacol	5 grams
Sterilized liquid vaselin	100 grams.

If desired, the quantity of iodoform in such solutions may be increased four or five times. The guaiacol may be used alone—5 parts dissolved in 100 parts of oil. Gomerol, a substance somewhat resembling guaiacol, and obtainable either pure or in a 10 per cent. oil mixture, has been recommended in the treatment of tuberculosis; it is given either internally or applied locally by means of 10 per cent. instillations of the drug suspended in oil; it has also been used in the form of irrigations (1 : 500) for the relief of tubercular cystitis. From experiments carried on by the writers they conclude that the drug is comparatively harmless, and although they are not enthusiastic over its use, they consider it worthy of further investigation.

STONE IN THE BLADDER

The frequency with which stones occur in the bladder apparently depends to a great extent on climate. In the writers' experience,

cases of vesical calculi are not numerous in New York city or its immediate vicinity. In some European countries, especially in England, and in India they are quite prevalent.

The symptoms of stone in the bladder resemble closely those of chronic cystitis, with or without enlargement of the prostate, a condition that is often associated with the presence of vesical calculi. The patients generally complain of some disturbance of micturition, which is more noticeable during the day than at night,

Fig. 133.—Cystic calculi (from the B. Farquhar Curtis collection in the Museum of Carnegie Laboratory): *a*, Calculus mostly composed of ammonio-magnesium phosphate, weight 20 Gm. (reduced one-half); *b*, stone largely composed of calcium oxalate, weight 4.8 Gm. (reduced one-half); *c*, fragments of calculi formed about a silk suture (*c'*) left in the bladder after a suprapubic cystotomy; *d*, uric acid calculus (natural size); *e*, mixed calculus, largely phosphatic, weight 30 Gm. (reduced one-half); *f*, small, hard oxalate calculus (natural size); *g*, mixed calculus, largely alkaline phosphates, weight 13 Gm. (one-half natural size).

and is apt to be augmented by exercise. Riding over a rough road or any act that tends to cause congestion at the base of the bladder aggravates this symptom. The urine is generally turbid, and indications of catarrhal or purulent cystitis are present. A useful diagnostic point is that occasionally, while the stream of urine is quite strong, it is suddenly completely checked, without any dribbling taking place, as generally occurs when the urinary volume, is diminished owing to prostatic hypertrophy. After a time the patients are again able to urinate as freely as ever.

This interference with urination is due to the stone falling up against the opening of the urethra into the bladder.

In examining for suspected stone, and also to get an insight as to the size and condition of the bladder, and to learn the general feel of the bladder (the bladders of old persons, as is well known, often present ridges that are easily distinguishable), the Thompson searcher (Fig. 13) is the instrument generally used. In the absence of a Thompson searcher a medium-sized steel sound may be employed. Dr. Chismore has modified the Thompson searcher so that it represents an instrument of the same curve and length as his lithotrite.

After the bladder has been emptied, several ounces of fluid are injected into it through a catheter; or, the searcher being hollow, the fluid may, if it is preferred, be injected through the nozle of the syringe placed in the opening at its upper end; the searcher is introduced into the bladder, and pushed to the back wall, carefully avoiding inflicting injury, its beak pointing upward; then, by means of its handle, the searcher is revolved a little from one side to the other, and is gradually withdrawn until it reaches the urethral opening into the bladder. Now, the searcher being revolved a little on its passage from the back to the front wall of the bladder, it will strike the bladder-wall first on one side, and then on the other, at the urethral orifice. The searcher is divided off into inches and their fractions, and there is a small sliding scale that moves up and down on the shaft of the searcher. It should be noticed, as it strikes the anterior wall of the bladder, being revolved from side to side, whether it meets with an obstruction on one side sooner than it does on the other. If it does, this indicates generally a lateral enlargement of the prostate on the side that shows the obstruction first. After this procedure has been completed, the searcher may be pushed to the back wall of the bladder again and completely rotated, so that its beak points downward toward the base of the bladder. It may then be brought forward and rotated from side to side, as was previously done, except that this time the beak points downward. When it approaches the urethral orifice, it will naturally meet with an obstruction to its entire removal, for the reason that its beak is lower than the urethral orifice; if, however, there is much third

lobe enlargement of the prostate, a practised hand may be able to detect this from the angle that the searcher assumes or from the feel of the obstruction as the searcher strikes it. If a stone in the bladder is present, it will very likely be encountered with the end of the searcher on its journeys back and forth, as described. If the searcher strikes a stone, a characteristic feel will be imparted to the hand and sometimes a click will be heard. When this is noticed, the angle should be carefully observed, and also, by means of the measuring scale, the distance should be carefully gaged, and the searcher withdrawn and a Chismore lithotrite introduced, when, if it is placed at exactly the same angle and at the same distance as shown by the measuring scale, the stone should be reached. In using the searcher for detecting the presence of prostatic enlargement it is a good plan, after the obstruction has been encountered, to introduce a finger of one hand into the rectum, the other hand holding the searcher in the bladder; the distance between the searcher and the finger may then be estimated. The same procedure may be followed when the searcher strikes a stone, but care should be observed not to move the stone too much if it is to be crushed immediately, or it will get out of position. It would hardly be necessary to describe this simple procedure in such detail were it not for the fact that it lends valuable aid and is a method that, the writers find, is very often neglected by the general practitioner and by the members of house-staffs in hospitals. If there is any doubt in the mind of the surgeon as to the condition of the bladder and as to the presence or absence of stone (further than is furnished by the searcher), a small exploring cystoscope should be introduced and the bladder-walls examined with the aid of electric light.

As is well known, in cases of third lobe prostatic enlargements a pocket-like sacculation is formed at the base of the bladder, beneath the projecting third lobe; this pocket is often a favorite site for the lodgment of a calculus. Once a stone has become lodged here, it is somewhat harder to reach with the lithotrite, and, if the instrument is reversed, it is possible for a careless operator to grasp the third lobe between the two jaws of the instrument and, by crushing, do an immense amount of damage. Even if an enlarged third lobe is not present, the rectovesical

Fig. 134. — Bigelow's lithotrite.

fold may project up into the bladder at the base, making an apparent sacculation that may also, if care is not used, be grasped between the jaws of the reversed lithotrite and damaged. It is better in these cases first to ascertain the effect of throwing a current of fluid into the bladder, for by this means the stone may be thrown into the jaws of the lithotrite, and careless manipulation with the beak of the instrument reversed thus be obviated.

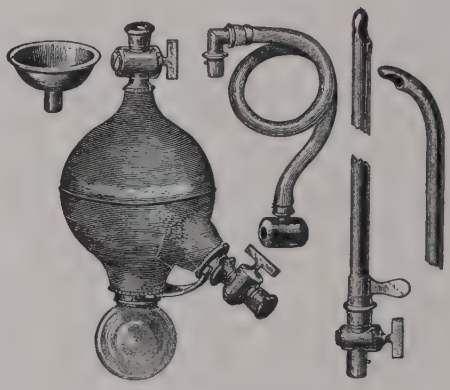


Fig. 135.—Bigelow's evacuator.

Litholapaxy

The operation of litholapaxy, or that of crushing and evacuating stones in the bladder by means of instruments devised for the purpose, has been employed since the early part of the nineteenth century. A great many modifications, both in technic and in the instruments themselves, have been made from time to time. Space will not permit of a detailed historic account of the development of this interesting operation. It may be briefly stated, however, that the original instruments for crushing stone were devised by French surgeons. An important modification was the invention, by the late Dr. John Bigelow, of Boston, of an evacuator, which, by aspiration,

removes the fragment of the stone. Later on an important advance was made by Dr. Joseph D. Bryant, of New York, who devised an instrument that served both as a crusher and an evacuator. In this the female blade of the crusher encircled a catheter, so that the bulb of the evacuator could be attached to the handle of the crusher, and fluid removed from the bladder through a hole in the female blade, or forced into the bladder by means of the aspirating bulb through the same blade, thereby creating a current in the bladder that washed the stone or fragments of stone in between the jaws of the crusher. The late Dr. George Chismore, of San Francisco, a recognized authority on operations for the removal of vesical calculi, performed this crushing operation on 154 cases of stone in the bladder. He kindly placed at the writers' disposal not only his detailed description of the valuable modifications of the operation as devised by him, but also his history book and the manuscript of a forthcoming treatise on the subject, written by him and his associate, Dr. Edward Giles McCormick, of the same city. From personal experience in the past the writers prefer to effect removal of a stone through a suprapubic opening rather than to attempt to crush it; Dr. Chismore's modifications of previous instruments seem so ingenious, however, and his results, which are fairly stated, have been so good, that it has convinced us that there may still be a fruitful field for the operation of litholapaxy.

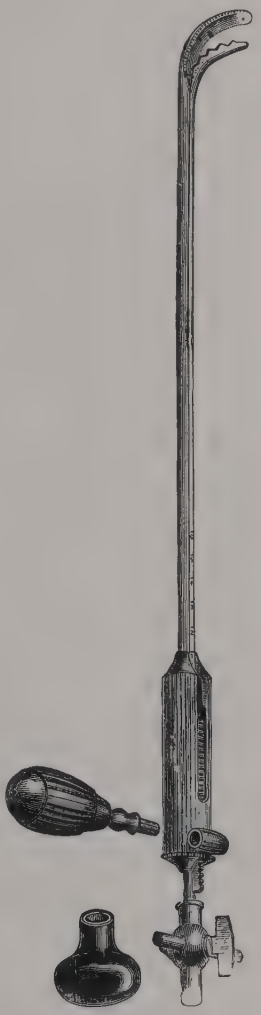


Fig. 136.—Chismore's evacuating lithotrite.

Dr. Chismore's first modification consisted in the making of a catheter in the male blade. This catheter has a large eye, so that

good-sized fragments can be sucked through when the evacuator bulb is attached to the handle of the crusher; the second advantage of this modification is that a stream of water can be forced through the catheter in the male blade, thus sending a current of water into the bladder, which loosens up stones, and, through the force and direction of the current, brings them into the jaws

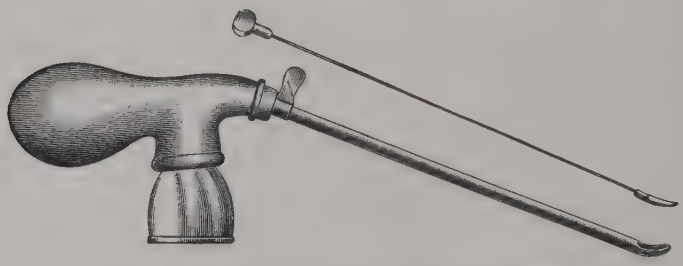


Fig. 137.—The Chismore bladder evacuator and obturator.

of the crusher and so sometimes prevents the necessity of turning the crusher around with its beak pointing toward the base of the bladder. Dr. Chismore has also invented a hammer for use when hard fragments of stone are caught between the blades of the crusher, and cannot be crushed by the hand-screw on the end of the instrument or by an assistant using a ratchet and pinion on the side of the instrument. This hammer is attached to the crusher while in position, and works on the principle of a pneumatic drill. It resembles in action a hammer such as dentists use in filling teeth.

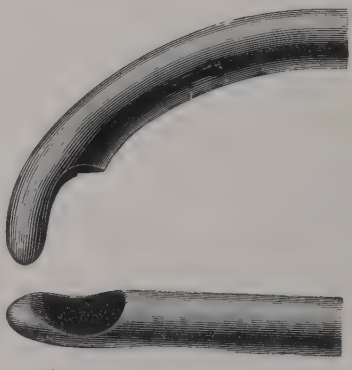


Fig. 138.—Curved and straight evacuating tubes for removing fragments of crushed stone.

Technic.—The Chismore lithotrite is prepared for use by lubricating the male blade freely with a stiff ointment of lanolin to which ten grains to the ounce of boric acid has been added, working it back and forth until the lubricant is thoroughly distributed be-

tween the male and female shafts. This serves as a packing to prevent the ingress of air and the egress of fluid while aspirating. This point is important and must not be neglected, for if it is, fluid will escape freely from the bladder between the shafts of the male and female blade when the aspirator is compressed, and air will rush in when the bulb is relaxed, thus rendering the procedure a partial or even a total failure. Two aspirators should be on hand, from which the air should be withdrawn by a syringe. (When seeking a stone with a searcher, if the stone is found, an attempt should be made to find its farthest border, and, having found it, the index on the searcher at the meatus should be set, and an effort made to approximate its size by withdrawing the searcher until its nearest border is felt. Note the angle that the shaft of the searcher makes with the axis of the body. The stones are generally found, according to Chismore, in the region of the base of the bladder, to one side of the median line—most frequently the right.)

The stone having been discovered and located, ordinarily an attempt should be made to crush it immediately.

One and one-half to three ounces of a warm 1 per cent. solution of cocain should be injected into the bladder through the searcher or through a catheter. Chismore recommends that the operation be done with the bladder as nearly empty as is convenient, and considers that nothing but harm follows the strenuous use of antiseptic solutions employed for the purpose of rendering the bladder-wall as clean as possible.

In about five minutes the bladder should be anesthetized; then the lithotrite may be introduced, great care being taken to overcome spasm and to proceed with gentleness in passing the triangular ligament. Carry the instrument to the further end of the stone, and then go still a little further. Open the shaft to a width that will accommodate the stone if the size is known. Deflect the beak in the direction in which the stone is known to be, seeing that the angle is the same as was the angle of the searcher, and close the jaws of the instrument. If the stone is not grasped the first time, another effort should be made. If this does not succeed, gently push the bladder up with the female

blade and depress the jaws by elevating the handle of the instrument, thus giving the bladder a V shape with the instrument in the angle of the V. Squeeze in an ounce or two of fluid by coupling on the aspirator, then sharply relax the aspirator bulb so that the fluid will be drawn out again, for it is possible that in this way the stone will be drawn into the jaws. It may be necessary to repeat this maneuver over and over, varying the angle of the shaft, or perhaps reversing the jaws, which should be very frequently closed in order to determine whether the stone has been seized. When the stone has been secured, manipulate it slightly, so as to ascertain that the bladder-walls have not been grasped as well.

There are three methods of crushing a stone: One is by the use of the hand-cap; another is by means of the ratchet and pinion; and a third is accomplished by the aid of the hammer. The line of procedure is as follows: First try the hand-cap; when that fails, let an assistant use the pinion; this failing, let the assistant hold the stone as firmly as possible with the pinion while the operator fixes the hammer; holding this in his right hand, he makes firm pressure on a line with the shaft of the lithotrite—this pushes the piston slightly inward and sets it. Then, with the first and second fingers of the same hand, he brings the lugs sharply home; this releases the hammer and delivers the stroke; the left hand, in the meantime, holding the female blade of the lithotrite, controls the position of the jaws within the bladder and also furnishes the counterresistance to the force of the hand-cap, pinion, or hammer. The stone being crushed, the aspirator may be used again to remove the fragments, or a larger tube, to which the aspirator may be attached, may be introduced for evacuating the material.

If there is much pain, the cocain solution may be released and a fresh one injected. When the operation is over, the cocain solution should be washed out with a small quantity of boric acid. The after-treatment is simple. The small fragments that remain after thorough aspiration will generally pass out of the urethra spontaneously, but if there are indications that large fragments remain, after a few days a litholapaxy tube may be introduced to remove them.

In elderly and feeble patients and in those with enlarged prostate, particularly enlargement of the third lobe, even greater care and gentleness are necessary, and several attempts may be needed before the stone is finally reached. In such cases the stones are generally lodged in the pocket behind the third lobe, and if the jaws of the instrument are reversed in order to reach them, care must be used, as was previously directed, lest the third lobe be grasped between the jaws of the instrument or a fold of the rectovesical membrane be crushed. It is a good plan, after the stone has been seized by the lithotrite, to rotate the instrument slightly to be certain that no mucous membrane has been seized.

After the stone has been crushed, if fragments get in behind the third lobe, they are very often, after a few days, washed out. Here, as in many conditions of the genito-urinary tract of similar nature, when the patients are so much enfeebled that heroic measures cannot safely be undertaken, time is an important factor. As regards the results that may be expected from the removal of vesical calculi, these are dependent on the individual case. It is not to be expected that in an old man with a large prostate, chronic cystitis and incontinence of urine would entirely disappear after the removal of a stone, although a large measure of relief will generally follow. When, however, no complications exist, a complete cure will naturally be expected to follow. It is the writers' belief that in New York and its vicinity the treatment of stone in the bladder by litholapaxy has not received sufficient attention in the past, the tendency, in almost all cases of vesical calculi, to perform suprapubic cystotomy being on the increase. It is difficult, however, to formulate a series of rules that will be applicable to all cases. Suprapubic cystotomy, when good after-nursing can be assured and the patient is in a fair degree of health, will probably, with many surgeons, be the operation of choice, since under such circumstances the danger of a suprapubic fistula forming is reduced to a minimum, and the operator can be certain that the stone has been entirely removed. On the other hand, in dealing with patients with stone in the bladder who are unwilling to submit to a cutting operation, who are aged or very infirm,

or when it is not possible to obtain good after-treatment, litholapaxy is to be preferred.

Remarks on the Removal of Vesical Calculi.—In cases of stricture of the urethra that will not easily permit of the introduction of the lithotrite, the stricture should be well dilated before any attempt is made to do litholapaxy. In elderly persons a stone in the bladder will often be found associated with enlarged prostate, and it is well, therefore, when doing a prostatectomy, to examine the bladder for stone, and if one is found, to remove it through the opening used for prostatic enucleation. In two cases seen by the writers it was found difficult to remove the stone through the opening made for a perineal prostatectomy, and a suprapubic opening was also required.

Encysted stones may frequently be detected by the searcher, or may be seen by the cystoscope, but the surgeon will find that he is unable to remove them. In attempting their removal a suprapubic cystotomy is the operation to be preferred. Chismore has found that oxalate of lime stones are those most frequently encountered; next in frequency come the phosphatic calculi, whereas the uric-acid formations are least likely to occur. Occasionally stones form very rapidly, large quantities of gravel coming down from the kidney acting as a nucleus. Sometimes the crushing must be repeated every two or three months, or the stones may not reform for several years. Dr. Chismore operated fifteen times on one man. The bladder should be inspected very carefully about a month after a stone has been removed, and, if possible, the patient should be kept under observation and be seen several times a year.

Bladder Puncture.—This is occasionally done for temporary emptying of the bladder, by means of an aspirating needle or a trocar. It is generally used as an expedient for temporary relief of distention preceding some operation which may have to be temporarily delayed. The puncture should be made as near the pubes as possible, so as to avoid wounding the peritoneum. It should be made as exactly as possible in the median line of the abdomen, so as to avoid wounding the veins on the outer surface of the bladder. Every possible precaution should be taken as to the sterilization of instrument and cleanliness of the field of

operation. In doing retrograde catheterization, occasional successful attempts have been made, through the use of a trocar, to perform retrograde catheterization. The operation, however, is not one that ordinarily commends itself to the surgeon. In the past this operation was most often performed for retention of urine due to obstruction, such as that caused by an enlarged prostate. The trocar, or aspirating needle, should be made to penetrate for a distance of one and one-half to two and one-half inches from the surface of the abdomen, according to the amount of fat present in the abdominal walls. It is safer, in order to avoid wounding the peritoneum, to make a very small preliminary incision immediately above the pubes down to the bladder-wall before making puncture. When obtainable, a curved instrument should be used with its concavity pointing toward the pubes.

Curettage of the Bladder

A general cleaning up of the walls of mucous membrane of the bladder is, in our experience, a useful procedure in cases of old chronic cystitis, especially in a certain type seen most generally in elderly people of poor general condition, where the chronic cystitis seems to be changing into a general malignant growth. This cleaning-up process should involve only the mucous membrane of the bladder, and great care should be taken not to invade the muscular coat. It is best performed through a suprapubic opening, with the bladder well illuminated, through the use of a curette. If it seems practical, this curettage should be aided to some extent by the galvanocautery. These cases in our experience following such a procedure do surprisingly well for a time, the bladder opening healing up, pain diminishing, and the character of the urine improving, but as such cases are generally seen in hospital wards and in patients whose general condition leaves much to be desired, the prognosis as regards any long lease of life should be guarded, as death is liable to ensue within a few months, if not primarily due to the chronic inflammatory condition of the bladder, from some intercurrent disease.

It is somewhat difficult to give very precise direction as to the best manner in which this curettage, if curettage it can be called, should be performed, as, in our experience, which has been quite

considerable in this class of cases, each individual case differs somewhat from the preceding. Such cases, particularly where they are met with in old thin, cachectic individuals, are very liable to have extremely thin and friable bladder-walls, and while the removal of the diseased tissue to as great an extent as possible seems to be attended with very good results, great care and gentleness is required to prevent punctures of what little is left of the muscular coat of the bladder-wall. Simply scraping such growths off with the finger is sometimes all that should be attempted.

Suprapubic Cystotomy

This operation of opening the bladder through the abdominal wall has come into more general use within the past twenty years, and, the writers believe, its present popularity is well merited. It is now to a great extent the operation chosen for the surgical relief of stone in the bladder, and it is very frequently employed when the prostate is to be also attacked. The difficulties attending the performance of this operation have been somewhat exaggerated. There are, however, certain practical objections to its indiscriminate use. One of these is that the peritoneum may be wounded; this objection is overcome in large measure, however, if proper small catgut sutures are kept at hand, and if the wound is immediately sutured, for but little harm will result. The greatest practical objection to its performance is the difficulty with which the suprapubic wound heals after the operation. Much depends on keeping the edges of the wound clean; these are soiled by the urine that is continually flowing through the suprapubic opening. In any given case, therefore, in which the surgeon feels assured that the patient will receive the proper attention after the operation, it is often the operation of choice. When doubt exists as to the efficiency of the nurse, or when it is questionable whether or not the wound will receive the proper attention, some other method of entering the bladder should, when possible, be attempted. This operation is almost never performed on the female. The technic of the operation is as follows:

The pubes and scrotum having been shaved and the operative toilet having been carefully made, the bladder should be washed

out, and as much of a saturated solution of boric acid should be injected through a catheter into the bladder as the organ will comfortably hold—usually about one pint.

After the bladder has been filled, a catheter should be tied around the root of the penis, to prevent escape of the fluid. It not infrequently happens that during an operation through the perineum for the relief of prostatic hypertrophy, it is decided to open the

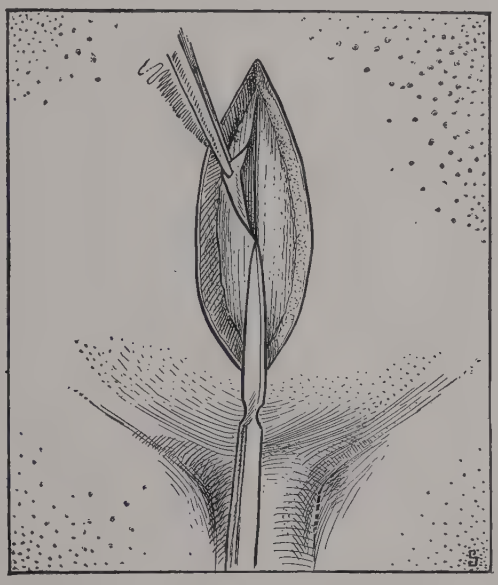


Fig. 139.—Suprapubic cystotomy (Lejars).

bladder from above. When this step is determined upon, it will not be necessary to inject fluid into the bladder, but if there is sufficient room in the urethra, an ordinary steel sound may be passed into the bladder, and the tip of the sound be cut down upon suprapubically. If for other reason it is found desirable to open up the bladder without filling it, the same measures may here be adopted. By the latter method of performing the operation, however, the danger of wounding the peritoneum is somewhat increased. The bladder filled, the head of the table should then be somewhat lowered, so as to bring the operative ground a little more prominently into the field and to help to keep the peritoneal fold from the front of the bladder.

Having placed the patient in the proper position, a straight incision, about six inches long, beginning just below the upper border of the pubic bones and passing directly upward in the median line, should be made. The length of the incision through the skin will depend somewhat on the amount of fat in the individual, a fat person requiring a longer skin incision than a thin one. The skin is cut through, and then the white line of the muscle-fibers is incised. At the lower part of the wound the small fibers of the pyramidal muscles may be cut through or pushed to one side, and the muscular aponeurosis of the underlying muscle cut through, when the yellow prevesical fat will appear. When this is seen, the bladder-wall is near at hand; it is well then, with the finger or the handle of the knife, to press the fat as far as possible out of the way. In cutting through the tissues just mentioned as being surrounded by the fat, a few small vessels may be severed; there being no large ones in this region or very close to it. Such vessels as are cut through should be immediately ligated, thus keeping the approach to the bladder as clean as possible. Venous bleeding, which is sometimes considerable, will generally cease when the bladder-wall is cut through. When the bladder wall is approached or when it can be outlined with the finger, it is well to pass a sharp hook through what appears to be the wall, keeping as near as possible to the superior border of the pubes, the wound through the skin and muscles having been held open by retractors. Having hooked the blad-

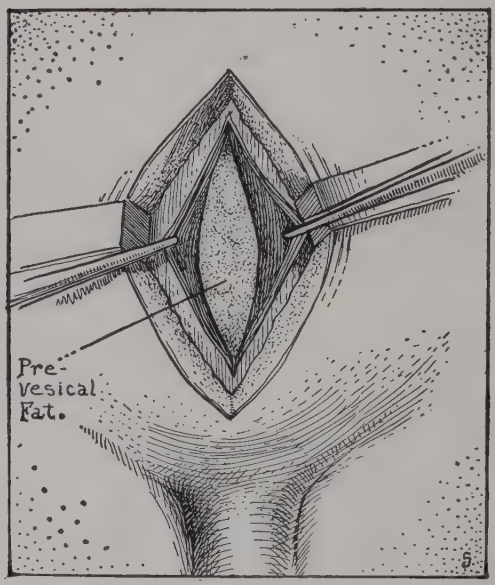


Fig. 140.—Suprapubic cystotomy (Lejars).

der-wall, a very small puncture should be made to one side of the hook, as near the pubes as possible; the escaping fluid will indicate that the bladder has been punctured. Before proceeding further, examine carefully to see if the peritoneum has been wounded. If this has been done, the peritoneum should be repaired, and then

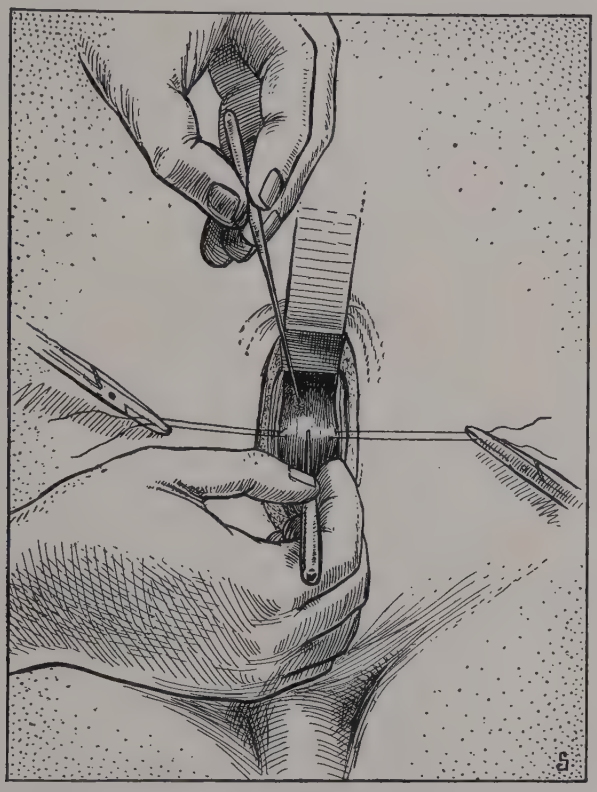


Fig. 141.—Suprapubic cystotomy. Right hand incising bladder, left hand holding hook (Lejars).

pushed as far as possible out of the way. Having punctured the bladder, a ligature should be passed through the bladder wall on one side, and a corresponding ligature on the other; the hook should then be removed, the wound in the bladder wall being held open by an assistant pulling on the ligature on each side; the incision should be extended upward as far as may be required, or far enough to allow the introduction of one or two fingers into the opening in

order thoroughly to examine the inner bladder-wall. In performing operations on the bladder the writers find it most convenient to have at hand a small portable electric light, about the size of a pea, on a flexible wire; this they drop into the bladder in order that the existing conditions may be seen as well as felt. In operations done for the simple extraction of a stone, this procedure is unnecessary, for the stone can be grasped at once. If desired the bladder wound may be enlarged by placing a retractor in each side of the wound and a third retractor in the upper end of the incision, the ligatures preventing the bladder from sinking back into the pelvis.

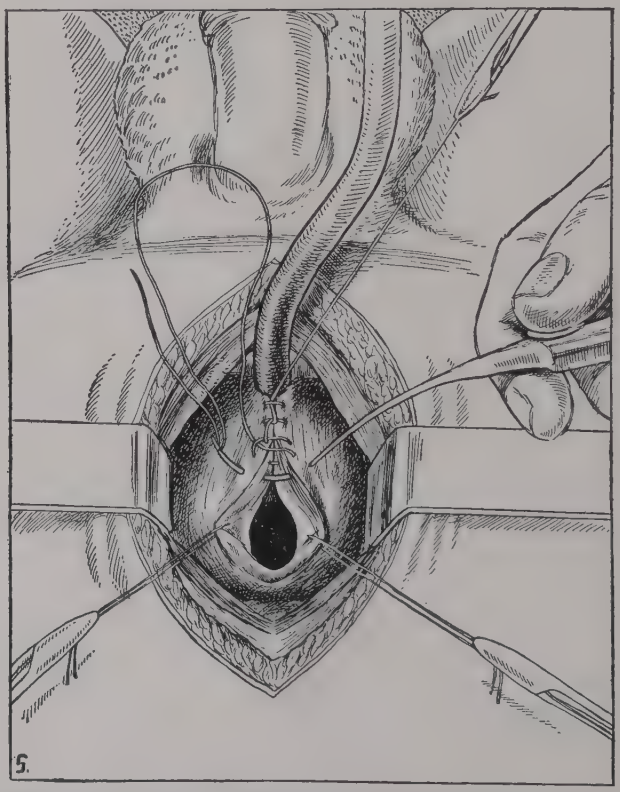


Fig. 142.—Suprapubic cystotomy. First layer of non-perforating sutures (redrawn from Albarran).

The bladder having been opened and thoroughly examined, and any wound in the peritoneum having been repaired, the important question to be next considered is that of the repair of the

bladder wall. It is becoming more and more the custom, particularly in Europe, to try to obtain primary union of the bladder wall through sewing the wall up immediately following a suprapubic cystotomy, and trust for drainage to a retention catheter introduced through the urethra. Ordinarily, this procedure will only be effective in a non-infected bladder, and

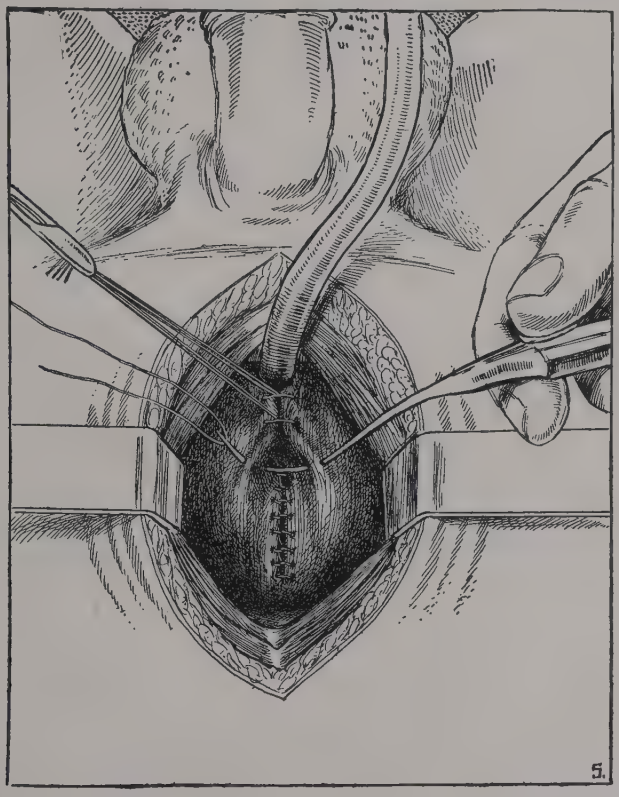


Fig. 143.—Suprapubic cystotomy. Second layer of non-perforating sutures (redrawn from Albarran).

in such cases cannot be entirely relied upon on account of the difficulties which arise from the irritation caused by the retention urethral catheter. Unfortunately, it is so difficult to properly drain the bladder through the suprapubic wound that any other feasible method is to be desired.

The method of primary complete repair of the bladder wall following suprapubic cystotomy advocated by Albarran is prob-

ably the best, and is as follows: The retention catheter having been placed in the bladder emerging through the urethra, the wound in the bladder is sutured with catgut ligatures which approach to, but do not extend through, the mucous lining of the bladder. A small amount of fluid is then injected into the bladder through the urethral catheter and the wound is observed to

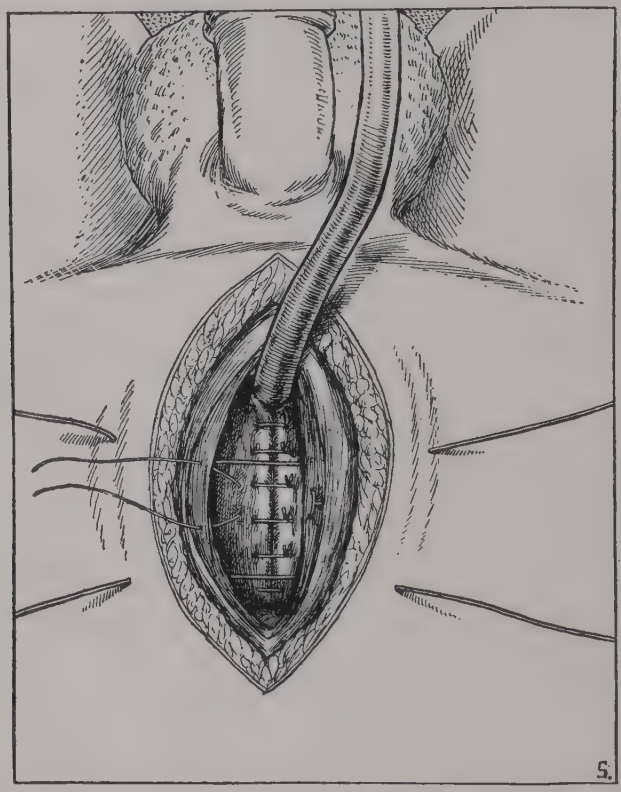


Fig. 144.—Suprapubic cystotomy, showing the two sutures of catgut which attach the bladder to the muscle and the two wire sutures which traverse the abdominal wall (redrawn from Albarran).

see whether it has been made water-tight or not. In case of leakage, one or more supplementary sutures are then made, sometimes a U-suture will be found most efficacious, and another observation is made as to whether the wound is water-tight or not. The bladder wound having been closed so securely that there is no leakage of fluid, a second layer of Lembert sutures is placed through the bladder wall, which fold in the primary layer and take in

some of the prevesical fat as well. These having been put in place, one suture on each side of the incision into the bladder is run through the bladder wall, but does not penetrate the interior of the bladder; this is attached to the under surface of the muscles surrounding the bladder, but does not penetrate the skin. This holds the bladder up a little closer to the abdominal wall, eliminating to some extent the amount of dead space. Two silver wire sutures are then run through the skin and the muscles and fastened, but are not allowed to touch the bladder wall itself. This is somewhat analogous to the method of suturing with the

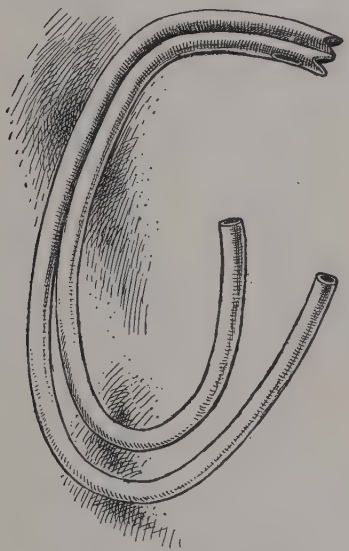


Fig. 145.—Guyon's tube.

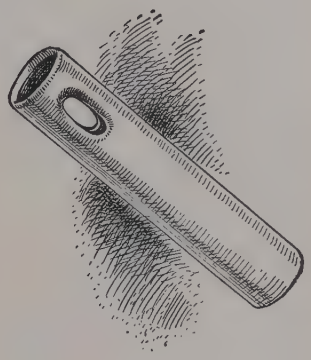


Fig. 146.—Freyer's tube.

silver wire recommended by Rousmorsky Kopulloff, mentioned in a previous edition of this book. A prevesical drain is placed just in front of the bladder between the bladder and the pubes, this is ordinarily removed forty-eight hours after the operation. This drain, whether a tube or gauze, does not penetrate the bladder wound. The silver wire is removed eight days after the operation. In addition to the silver wire, supplementary ligatures through the skin of catgut are placed in position. If possible the retention catheter is kept in position for six or seven days, when a new one is put in its place, which is definitely removed about the fourteenth day following the operation, and the patient

is allowed to sit up on the fifteenth or sixteenth day. We recommend the extra size silkworm gut in the place of the wire when impracticable to use the latter.

If there is an infected bladder it is hopeless to attempt to get primary union, and after the suprapubic cystotomy a drainage-tube should be placed in the bladder, but the general plan of ligatures should be as that outlined above, and they should be brought closely up to the tube, so as to leave as little space between the tube and bladder wall as possible.

Concerning the size of the tube or its shape, a good deal will depend on the individual opinion of the operator, and to some extent on the character of the operation. For an ordinary operation, such as stone in the bladder or for the relief of a small rtumo, of the bladder, a small rubber tube will suffice. Following an operation such as prostatectomy or for the relief of a larger tumor a large tube, such as the Frayer tube, may prove the most serviceable. A double-current tube may be used, like the Guyon, an illustration of which is given in the text.

When a tube is allowed to remain in the bladder for the purpose of effecting drainage, the bladder may be irrigated with a solution of boric acid through the tube, or through the retention catheter if one is used, several times a day. The older operative methods of opening the bladder, such as by lateral lithotomy, have become almost obsolete, and their description is, therefore, unnecessary. The removal of stones from the bladder, when any cutting operation is performed, is generally accomplished through a suprapubic incision.

Lateral Incision.—It is the custom of some surgeons, instead of making a longitudinal incision in the bladder in the performance of a suprapubic cystotomy, to make a lateral cut, keeping as close to the pubic symphysis as possible, and at right angles to it, the contention being that thus more room is obtained and the danger of wounding the peritoneum is diminished. The writers have seen one or two cases operated on in this manner, and although the method seems practicable, it does not appear to offer any great advantages. Some surgeons advocate that, during the performance of a suprapubic cystotomy, when the prevesical fat is encountered, the operator should introduce a finger just

under the edge of the pubes and press upward. In this manner the fat may be pushed up out of the way, and will carry with it the fold of peritoneum, which has a tendency to drop down over the front of the bladder. By this means also, it is claimed, the bladder-walls may be distinctly made out, both by their appearance and by the presence of the veins adhering to their outside surface. Theoretically, this may be true, but practically, under ordinary circumstances, and if the operation is one in which haste is required, too much time cannot be wasted on very fine dissections, but it is well to find the juncture of the peritoneum with the bladder.

An interesting case of suprapubic fistula came under the writers' observation some years ago. The patient suffered from paralysis of the compressor urethræ muscles following a perineal incision, and also from an operative suprapubic fistula. When he stood erect, the urine ran out through the urethra; but when he lay flat on his back, it escaped through the suprapubic opening. Since seeing this case the writers recommend that, in bladder operations, the head of the bed be slightly elevated to permit of thorough drainage downward. In making permanent suprapubic fistulas sutures not easily absorbable should be used to attach the bladder to the abdominal wall, or a long retention catheter may be employed when such attachment is undesirable.

CYSTOSTOMY

Cystostomy.—Cystostomy is the term applied to the operation of making a permanent suprapubic fistula. It is particularly useful as a palliative operation for inoperable tumors. The opening should be made in the bladder-wall well down to the pubes. Various modifications of this simple operation have been suggested, some of them with the idea that the permanent suprapubic opening can be made to act like a sphincter over which the patients will have control to a considerable extent.

A practical way is to sew the bladder-wall around a catheter and drop the bladder to its original position, and until the healing occurs to pack gauze between catheter and symphysis. If a catheter is not used, it is necessary to fasten the mucous lining of the bladder to the skin. If the catheter is not used,

the dressings should be changed frequently and the stitching of the mucous layer to the skin should be prepared very carefully to prevent infiltration into the space of Retzius. After good union has taken place between the mucous membrane and the skin, a certain proportion of patients will have some voluntary control over the fistula, and may be able to refrain from soiling the dressing for several hours at a time. Our personal experience with the retention catheter through the suprapubic opening has been good where the patient has been confined to a recumbent position, but if the patients are to be allowed to walk about, the permanent fistula without the catheter is the most

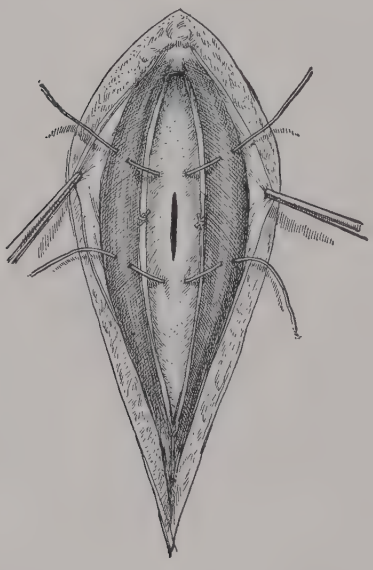


Fig. 147.—Operation of cystostomy. Sewing of muscular layer of bladder to abdominal muscles (redrawn from Pierre Duval).

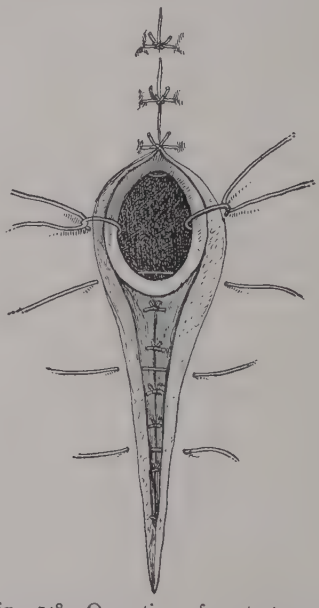


Fig. 148.—Operation of cystostomy. Sewing of mucous layer to skin (redrawn from Pierre Duval).

desirable. In our experience young patients with good muscular tissue have the best control over the suprapubic sphincter. The two illustrations show a very good way of making the fistula.

The operation can be divided into two sections, as shown in the illustration. The first part consists in the fixation of the muscular portion of the bladder-wall to the abdominal muscle. On each side a stitch is run through the muscular wall of the

bladder and through the inner surface of the abdominal muscle, not penetrating the skin. Then a stitch is run one above and one below these side stitches, which penetrates the muscular layer of the bladder, and each of the two abdominal muscles some inches from their border. Above and below the abdominal wall is sutured to the skin. All this is shown in the first illustration. Then the bladder is opened in the median line and the second part of the operation is proceeded with, which is shown in the second illustration. This consists in the suture of the mucous lining of the bladder to the skin. Two lateral sutures take in the skin and the mucous lining of the bladder. Then a stitch above and a stitch below penetrate the skin on two sides and in two places the vesical mucous membrane. The vesical orifice ought to be situated as near as possible to the bladder.

Suprapubic fistulas resulting from operations frequently become a source of much annoyance. They are more often encountered in hospital than in private practice, and usually heal with difficulty. In treating a case of suprapubic fistula following a previous operation it is well, when possible, not only to enlarge the opening and freshen the edges of the wound, as advised in most works on surgery, but also carefully to examine the bladder for the purpose of detecting any foreign substance that may have been left behind after the operation or which may have subsequently formed. The writers have seen one case in which non-absorbable ligatures were found in the bladder and were the apparent cause of the fistula; in another case a piece of gauze was found that was responsible for the non-union of the bladder wound.

In the case of a medical friend, who had been operated upon for papilloma of the bladder, the cause for the suprapubic fistula was found to be a piece of gauze, one yard long and two inches wide, that, through carelessness, was left behind after the operation. The urethra and meatus being large, the gauze eventually showed itself through the urethra to such an extent as to make its presence known to the attending physician, who extracted it through the urethral canal.

If the interior of the bladder has been examined and nothing has been found to account for the presence of the fistula, the edges of the wound may be freshened and sutured with a deep and a

superficial layer of sutures, a retention catheter being introduced through the urethra or a perineal opening for drainage made. It has been our experience that some of these cases have a tendency to fistula formation. It is wise to try the effect of a retention catheter before doing perineal section, for sometimes in the latter event the suprapubic fistula will heal but a perineal fistula will develop. Some suprapubic fistulas do well with occasional applications of nitric acid or the cautery. Often in such cases, particularly if there is any tubercular tendency, change of air or residence in the country will have a curative effect. Other methods failing, plastic operations must be resorted to.

TREATMENT OF BLADDER TUMORS

The symptoms of bladder tumor are painful micturition, changes in the urine, generally the presence of blood in the urine, and not infrequently pain in the neighborhood of the bladder. Tumor of the bladder may, however, exist for years without causing any symptoms at all. Such tumors are non-malignant and generally small in size. One quite common characteristic of most bladder tumors, and even of cancer, is the fact that they are very slow in their progress, even after the symptoms have shown themselves. Fatal results most frequently occur not from them, but from the invasion of other organs.

The diagnosis is generally comparatively easy on account of the history of the case, and can ordinarily be settled positively by a cystoscopic examination performed by one familiar with such work. It sometimes happens, in our own experience, as in that of other observers, that the contraction of the bladder and the easy bleeding of the bladder surface connected with a cancer or other tumor of the bladder renders it very difficult to make a satisfactory cystoscopic examination, viz., on account of the inability of the bladder to hold sufficient fluid and the impossibility of having the fluid in the bladder clear enough to obtain a proper view. In such cases a careful examination by means of a Thompson searcher may make the diagnosis very clear. The use of this instrument has been described in a previous portion of the book. The tumor should be investigated by a similar method to that employed in searching for stone, and

in measuring for the purpose of obtaining an accurate idea of the size of the prostate. Particularly in searching for tumor is it important to turn the instrument so that the beak will point toward each side of the bladder, then withdraw it as far as possible, and measure the distance. Diagnosis by this method can be made in certain cases, as has recently been demonstrated by one of us.

The tumor of the bladder having been located, various procedures may be instituted for its removal.

The suprapubic route is the most popular. After the bladder has been opened in the classical manner, a careful inspection of the tumor and of the urethral and the ureteral orifices should be made. If it is desired, one of the bladder specula so frequently

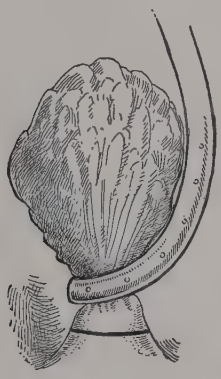


Fig. 149.

Fig. 150.

Fig. 149.—Showing method of making cone and line of incision. Cone is composed of the mucous layer and superficial muscular layer. The mucous layer is incised in a circular manner and the muscular layer resected as a cone from its submucous couch.

Fig. 150.—Scheme showing how, in extirpation of a tumor as in preceding illustration, there is a superficial removal of the muscular layer underneath the tumor, cone shaped (redrawn from Pierre Duval).

used by the French surgeons may be employed to distend the wound and hold it open. It is our custom to use, in operating on the bladder, the very small electric light attached to a flexible cord, called by electricians a pea-light, which is let down into the

bladder and which well illuminates its surface. It will probably not be necessary in the small pediculated growths of the bladder to do more than to nip off the growth from the pedicle and cauterize the base lightly. Except in cases of very small growths

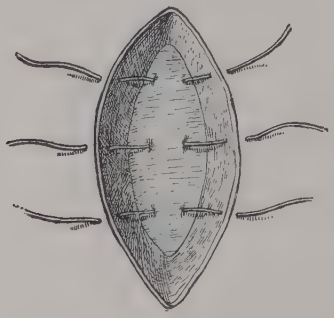


Fig. 151.—Method of closing cavity in bladder from which tumor has been removed (redrawn from Pierre Duval).

they should be removed by an incision into the mucous membrane of the bladder, the growth removed, and, whenever possible, the wound in the mucous membrane left by the removal of the tumor brought together by sutures. This manner of removing tumors of the bladder is shown in figs. 149, 150, 151). Great care should be used to gain as much union as is possible of the mucous membrane wound. Growths of larger extent, if deep, may require a deep incision, sometimes into the perivesicular tissues for their

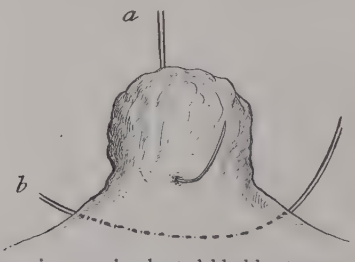


Fig. 152.—Showing how, in some implanted bladder tumors, a pedicle can be made by exerting traction on two transfixion needles introduced at right angles to each other. *a*, *b*, Transfixion needles (redrawn from Pierre Duval).

removal. If the neoplasm involves the orifice of the ureter, the ureteral orifice should be made in another portion of the bladder. The manner of removing a growth attached to the extremity of the ureter is illustrated in Figs. 156 and 157).

In order to prevent hemorrhage in removing a growth from the bladder it is wise to place the catgut ligatures in position, when

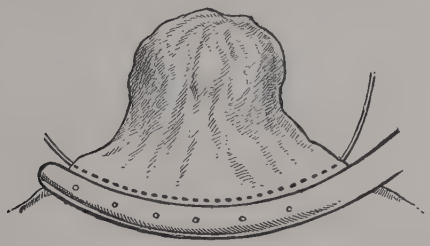


Fig. 153.—Illustrating the placing of the forceps at base of cone formed by the transfixion needles (redrawn from Pierre Duval).

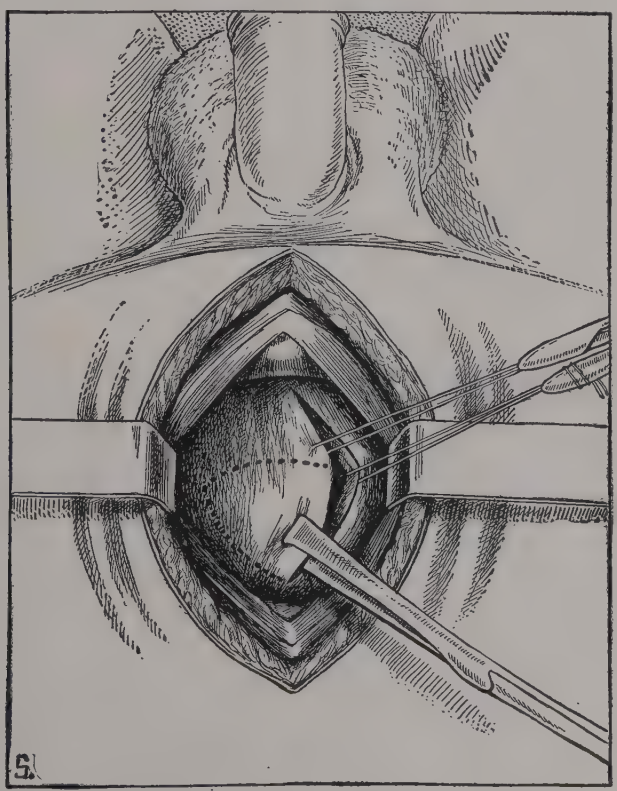


Fig. 154.—Resection of the bladder wall (redrawn from Albarran).

possible, which are to be used in sewing up the mucous membrane at the base of the growth, before removing the growth. This

makes it a little easier to control any hemorrhage which may ensue after the removal of the growth. Albarran suggests that if after hemorrhage still continues, a few stitches should be put in position running diagonally across the field, which will tend to make pressure from a different direction.

If an infiltrating growth be present, which is also extensive, and such growths are generally malignant, a more difficult situ-

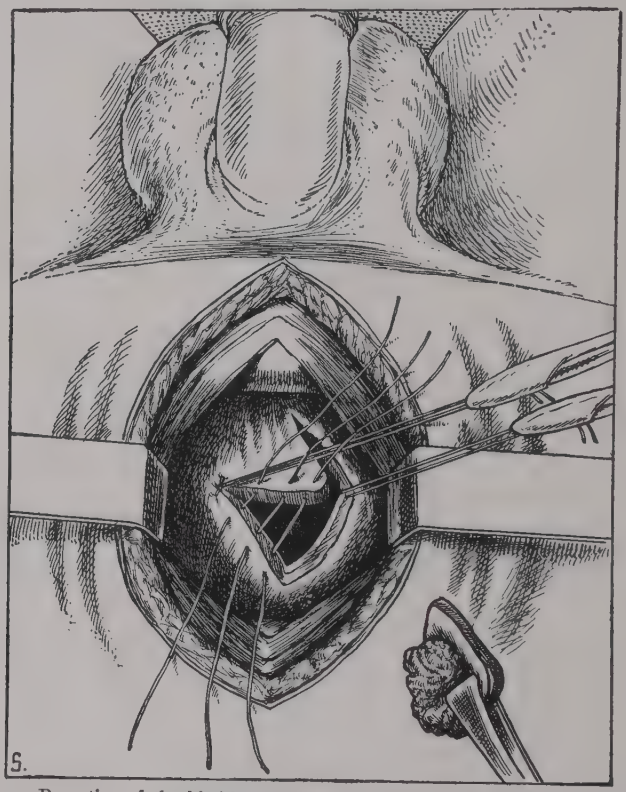


Fig. 155.—Resection of the bladder. Suture of the wall (redrawn from Albarran).

ation is presented. It is, of course, well recognized that some of the bladder tumors which are not malignant are associated with similar tumors in adjacent organs. Papilloma of the bladder and papilloma of the kidney are liable to exist together, while malignant growths of the bladder are very apt to be associated with the involvement of other organs, like the prostate. It has

seemed to us, from our clinical experience, where a growth in the bladder is malignant from a transformation of a previous benign bladder tumor, it is less liable to be associated with malignant growth elsewhere.

Malignant tumors of the bladder should be treated on the same lines as those laid down for benigh tumor, except that, when practical, it is wise to remove the prostate at the same operation, and some have advocated the removal of the adjacent lymph-nodes. Lymph-node hypertrophy may be largely inflammatory, and true metastasis of the cancer not have taken place. If the cancer is extensive, and has not involved the base of the bladder, a palliative operation, such as cystostomy, should ordinarily be the method of choice, or the bladder may be ablated, the ureters transposed to the intestine or the skin, or nephrotomy may be performed. If there is considerable involvement of the surrounding tissues, and the patient is not suffering much pain, in our experience cystostomy renders them quite comfortable, and the disease may go on for some time without causing marked changes in their physical well-being. If the cancer is more toward the fundus of the bladder, partial resection of the bladder may be attempted, with or without the transplantation of the ureters.

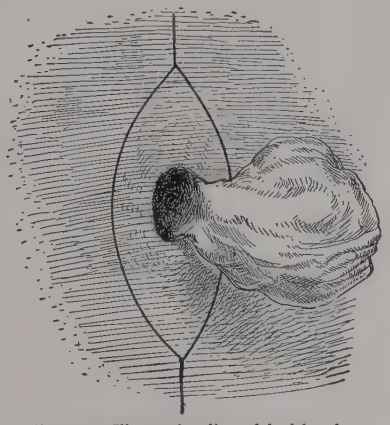


Fig. 156.—Illustrating line of incision for removal of bladder tumor involving orifice of ureter (redrawn from Pierre Duval).

In performing resection the shape of the part which is to be removed should, if possible, be of such a character that a good apposition of the surfaces left after the removal of a portion of the bladder can be made. The most useful form for the incision to take is well illustrated in the two pictures presented. The sutures should be so placed following a partial removal of the bladder of this character, that if possible they should not penetrate the mucous surface of the bladder.

Partial resection of the bladder is sometimes quite successful;

it is necessary, however, to leave about one-half of the bladder to carry on its functions.

The question of drainage after the removal of a growth in the bladder is quite an important one. Where very small non-malignant growths exist which have been simply tied off without incising the mucous membrane to any extent, the bladder wound should be sewn up immediately and the bladder allowed to drain through a retention catheter through the urethra. In cases where the bladder has not been infected and the growth has been of moderate size and it has been possible to bring the mucous membrane opening from which the growth was removed into good apposition, the same procedure may be tried. Where the growth has been large, and where it has been impossible to close accurately the mucous membrane incision, suprapubic drainage should be instituted through a Freyer's tube. No tube should be allowed to penetrate to the bottom of the bladder, and irrigation should be made most gently for the first four or five days, so as not to disturb any clot which may form at the place from which the growth has been removed.

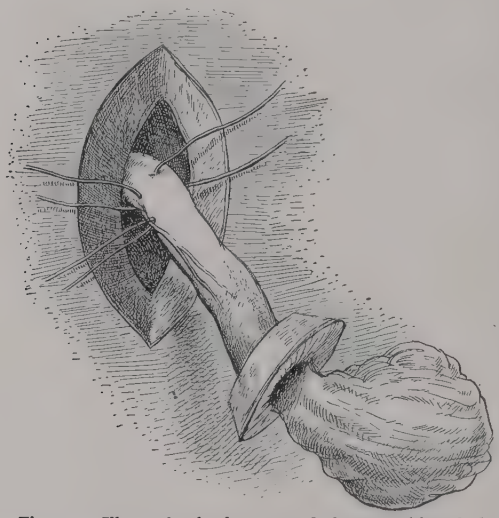


Fig. 157.—Illustrating further removal of tumor with end of ureter. Showing insertion of ligatures and ligation of accompanying venous pedicle (redrawn from Pierre Duval).

The Nitze operating cystoscope, previously described, is an ingenious apparatus through the aid of which a galvanic cautery snare can in some cases be placed about the pedicle of the tumor, and so be snared and cauterized off without necessitating opening of the bladder. The various attachments are so arranged that the snare can be thrown out at different angles. Up to the present time comparatively little work has been done with these instruments by American surgeons, although one or more of them have designed operating cystoscopes. This method will undoubtedly

come into more general favor as we become more familiar with the use of the cystoscope, mainly for the following reason: It is well known by all who have had occasion to operate on bladder tumors through the suprapubic route that they tend to recur, and it can easily be seen that any measure that will obviate the necessity for frequently reopening the bladder-wall will be regarded with satisfaction by both patient and surgeon.

The method of treatment of recurring bladder growths through the high-frequency current has already been mentioned earlier in the volume. The spark given off through the high-frequency current has a cauterizing effect, or some other form of cauterization of these growths may be attempted when desired through the instrumentality of the operating cystoscope. Other cystoscopic treatment of these bladder growths may be instituted through the Schapira cystoscope previously mentioned, or whatever form of operating cystoscope with which the surgeon is most familiar.

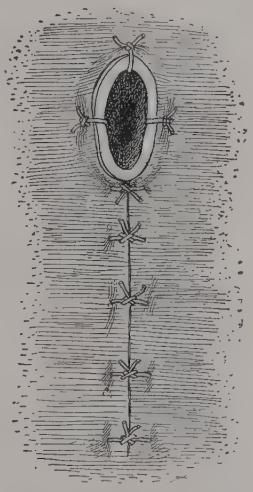


Fig. 158.—Suture of the resected ureter in the superior border of the bladder wound; suture of the bladder (redrawn from Pierre Duval).

Syphilitic ulcers and **neoplasms** of the bladder, which have been previously mentioned under the Pathology of Bladder Diseases, we believe and have stated in previous editions of this work to be very frequently the cause of chronic cystitis with contracted bladder. Before the more common use of the cystoscope clinical experience seemed to show that contracted bladder and syphilis went hand in hand. It is apparent now that these contractions are probably due to the after-formation of cicatricial tissue following syphilitic ulceration. The intermittent hematuria is an occasional symptom, and under the cystoscope ulcers deep or superficial, single or multiple may be found in their late stages, that of gumma sometimes resembling true bladder tumors. According to G. Gayet et Favre (Journal d'Urologie, July, 1914) these are not infrequently seen in old syphilitics who may have locomotor ataxia or myelitis or other syphilitic affections of the nervous system. Where there is any evidence pointing toward syphilis, the proper constitutional treatment should be

instituted, extending for quite a long period of time, several weeks, and its effects observed on the bladder by inspection, in a case of doubtful tumor, before resorting to operation. It has been our experience that often syphilitic affections of the urinary tract are slow to yield to treatment and that active treatment should be persisted in for several weeks before the local manifestations are necessarily much ameliorated. Gayet et Favre were in accord with this view, and mentioned one case in which ten weeks were required before a syphilitic ulcer of the bladder was healed.

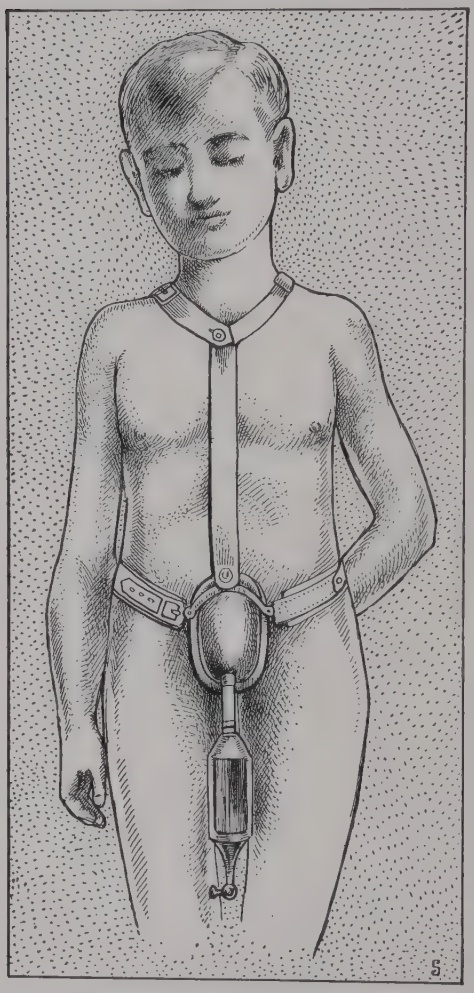


Fig. 159.—Apparatus used after Sonnenberg's operation for exstrophy of the bladder.

Foreign Bodies in the Bladder.—These may or may not present symptoms. Cystoscopic examination, however, will generally reveal their presence, if the searcher has not already done so. In doubtful cases an *x*-ray picture may be taken. When found, they can often be removed with the lithotrite, with long forceps, the forceps being in a tube containing a cystoscope,—an instrument devised by Casper,—or by making an opening into the bladder. It is the writers' experience that when fistula follows bladder operations or the removal of stone, the condition is often due to material left behind, such as dressings or unabsorbed ligatures; they

therefore recommend that a thorough search be made for foreign bodies at the time any procedure for the closing of fistula is inaugurated.

EXSTROPHY OF THE BLADDER

This dreadful condition is a congenital one, and, fortunately, of very rare occurrence. It is due to non-closure of the abdominal cleft. It may be partial, so that only a slight fissure is left near

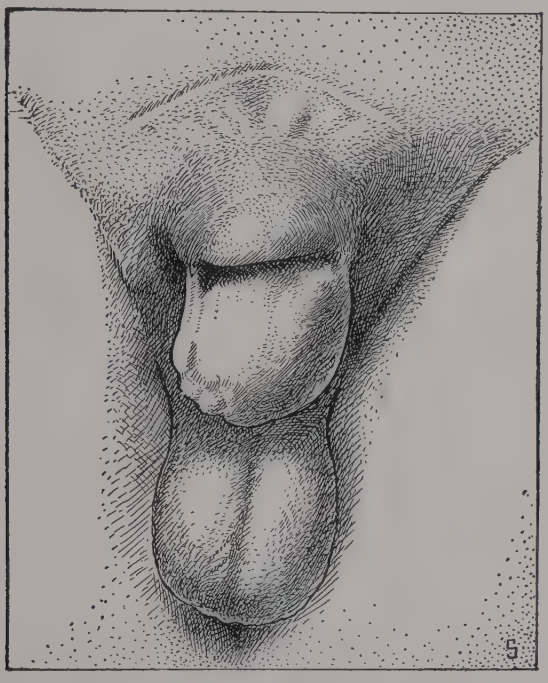


Fig. 160.—Scar on abdomen after Sonnenberg's operation for exstrophy of the bladder.

the urachus or at the lower angle of the cleft. If slight, stimulation of the edges or a slight plastic operation may result in closure. When complete in children so afflicted the anterior bladder-wall is absent, so that the posterior bladder-wall presents itself in the front of the abdomen. In males, epispadias coexists; hence such subjects, if they live to attain adult life, are so malformed that their genital organs are useless.

A great variety of operations have been performed for the at-

tempted cure or relief of this distressing condition. So far as cure is concerned, these operations have all proved unsuccessful. The results so far as relief is concerned are, however, somewhat better. Only an outline of the operations for the relief of this condition will be given here. In a general way the operations that have been attempted may be divided into three classes:

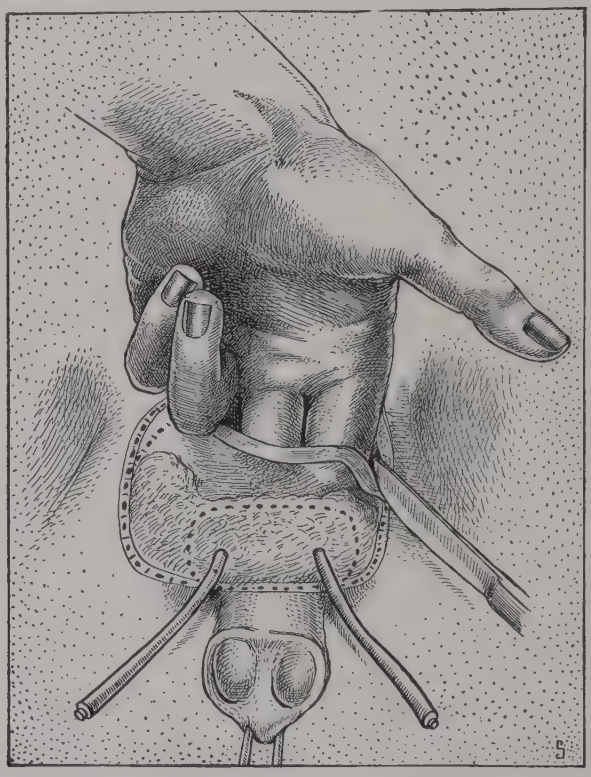


Fig. 161.—Maydl's method for exstrophy of the bladder. The abdomen is opened by an incision around the upper part of the bladder, using one or two fingers introduced into the abdominal cavity as a guide; the sides of the bladder are then separated. The peri-ureteral portion to be incised is shown by the dotted line.

Class 1.—This consists in separating the symphysis pubis in an attempt to fold and unite the two sides of the bladder-wall so as to make a complete bladder, an operation being performed at the same time for the relief of the hypospadias—in other words, to unite the borders of the bladder. There are several different modifications of this method.

Class 2.—This consists of various methods of grafting skin from a neighboring part or from the intestinal region, transplanting also a portion of mucous membrane, with the idea of making a cavity that will act as a bladder.

Class 3.—Measures that consist in excising the bladder entirely and transplanting the ureters into the intestinal canal—generally

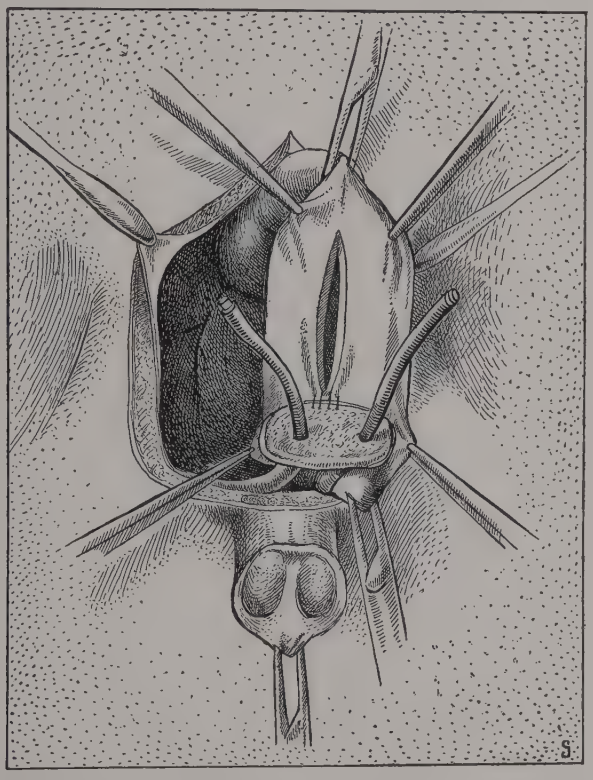


Fig. 162.—Maydl's method of operation for exstrophy of the bladder. The sigmoid flexure is incised along its free border, and is then fastened to the peri-ureteral portion of the bladder with catgut sutures.

into the rectum. The writers have never had the opportunity of operating on a case of this kind, but one has been brought under their observation that was operated on according to the last-described method by Dr. Frank Hartley, of New York. The patient was alive several years subsequent to the operation, and the rectum seemed very tolerant to the urinary flow. This is the opera-

tion of Maydl. The illustrations (figs. 161, 162, 163) furnish a clear idea of its nature. In this class also may be considered a series of operations that consist in transplanting the ureters into the penal gutter—the method of Sonnenberg, of which two illustrations are given (figs. 159, 160). The bladder is entirely removed in this method and it necessitates the constant wearing of a urinal.

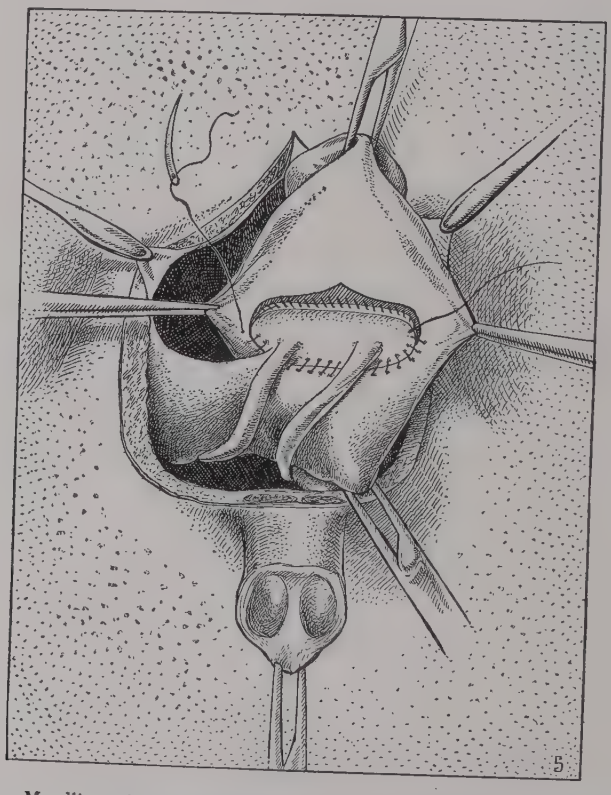


Fig. 163.—Maydl's method of operation for exstrophy of the bladder. The peri-ureteral portion of the bladder is inserted into the opening in the sigmoid and the edges sutured together.

(These operations are described in considerable detail by Berger and Hartmann in their "Text-book of Surgery," vol. ix; they also commend the article of Katz, "Traitemente Chirurgical de l'Extrophie de Vessie," "Thèse de Paris," 1902–03, No. 535, G. Steinheil, editor.)

Also should be considered in this class the method of Segond,

illustrated in figs. 164, 165, 166. This method consists in dissecting out the wall of the bladder pretty well down to the attachment of the ureters; then doubling it over and attaching it to the penal gutter; then making a hole in the underlying prepuce and pushing the gutter through so that the prepuce makes a hood. The bladder flap should be trimmed to fit, as

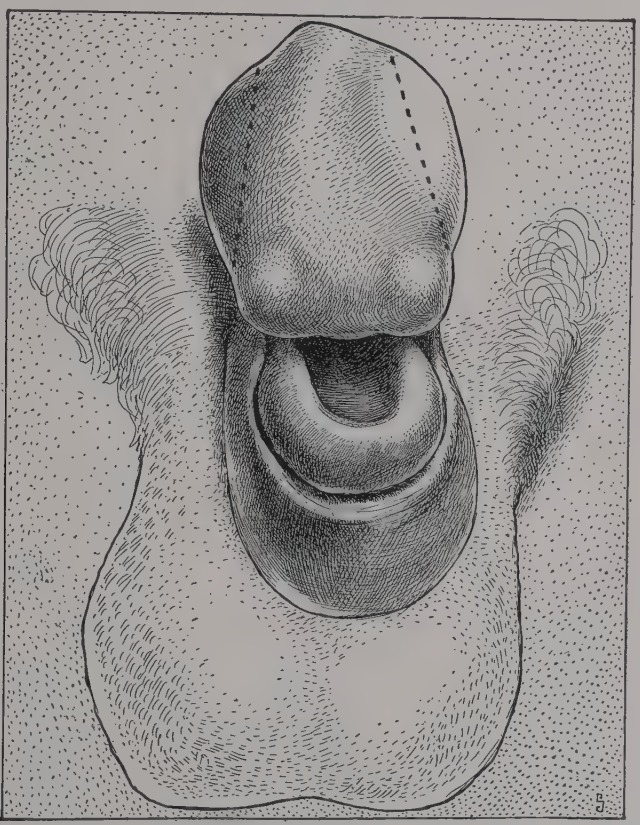


Fig. 164.—Segond's operation for exstrophy of the bladder. The under surface of the bladder-wall is pushed up and dissected along the dotted lines; it is then brought down upon the penal gutter.

the dotted lines in Fig. 164 show. The edges of the penal gutter should be freshened to unite them with the bladder flap. As much vesical tissue as possible should be left around the ureters when the flap is turned over. The upper border of the preputial hood can be united to and will help cover the opening in the

abdominal wall left by the removal of the bladder; if necessary, side flaps can be made to help cover in this latter.

We have very recently received from Dr. John T. Bottomley, of Boston, Mass., the report of a case of exstrophy of the bladder treated by what seems to us a very practical method, and that is

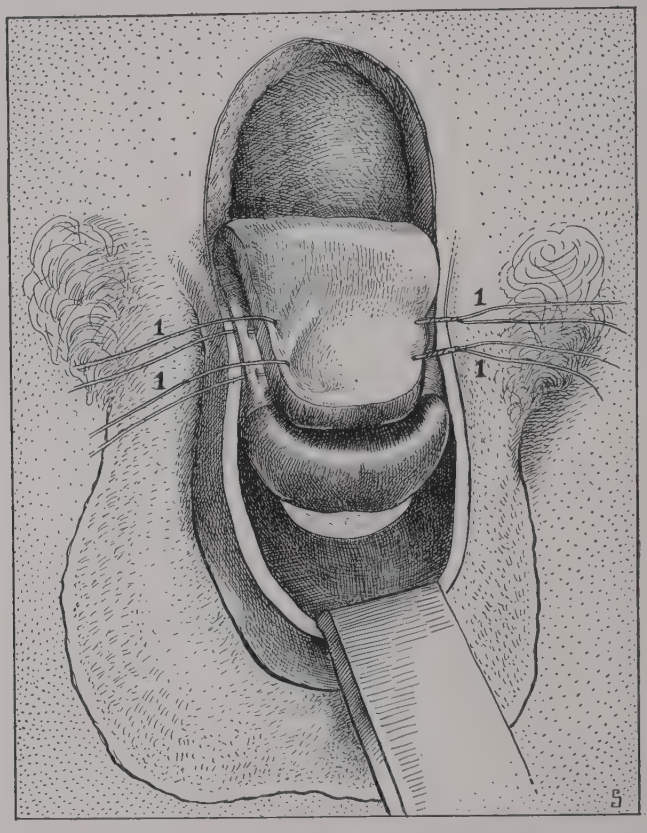


Fig. 165.—Segond's operation for exstrophy of the bladder. The borders of the penal gutter and of the adjacent skin are freshened, the dissected portion of the bladder-wall is brought down upon the penal gutter, and the two first sutures (1) are put in each side. The adherent border of the prepuce is then punctured transversely and turned inside out, and is spread apart by the retractor to show the extent of the raw surface which is to be brought up over the portion of bladder-wall.

the removal of the bladder which is preceded by the transplantation a few days earlier of the ureters to the skin of the loins. He has recently operated on a patient by this method, the report of the operation, as kindly furnished us by him, is as follows:

"Through an incision on either side of the abdomen about

parallel with the crest of the ilium go to the peritoneum; the latter structure is pushed forward, the ureter on either side is found, freed, cut across at the point where it crosses the iliac vessels, and through a small stab wound in the loin the end is

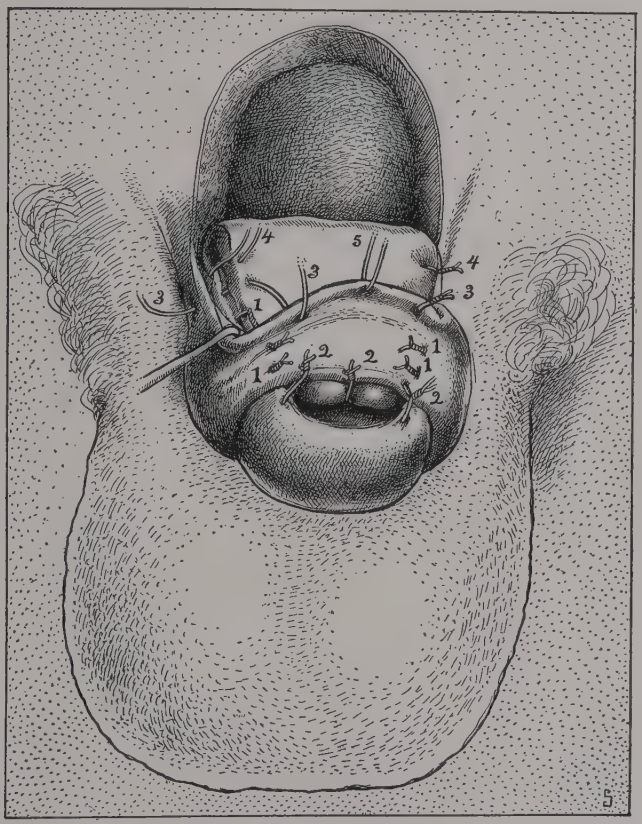


Fig. 166.—Segond's operation for exstrophy of the bladder. The dissected portion of the bladder has been folded down and fastened on each side with the sutures (1, 1), and the preputial hood has been raised over the penis and the raw surface of the dissected portion of the bladder. The sutures (2, 2) fix the shape of the meatus. The sutures (1, 1) have been passed through the prepuce so as to be removed afterward. The prepuce is lifted aside to show the course of the suture (1) on the right side. The suture (3) reunites the skin of the penis, the freshened border of the penal gutter, the dissected portion of the bladder, and the preputial hood. The suture (4) closes carefully the vesical fold near the ureter. The suture (5) will lift up the prepuce and fasten it to the skin of the abdomen.

carried out on to the skin of the loin and held there by sutures to the skin, about one-eighth inch of the ureter being allowed to project. Ten days after the preliminary operation the ectopic bladder is removed; the denuded area is covered in by grafting

and by skin flaps. The patient wears an apparatus for collecting the urine, is really very comfortable, there is no urinous odor, and the apparatus keeps the patient dry." Mr. Reginald Harrison,[1] in 1896, treated a case by removing one kidney and then transplanting the ureter of the remaining kidney to the skin of the corresponding loin. Dr. Bottomley in performing his operation attached the ureter of each kidney to the loin on the corresponding side.

INJURIES OF THE BLADDER

Injuries of the urinary bladder occur in the form of wounds, contusions, and rupture of the organ. In dealing with an injury of the bladder it is important to determine whether the lesion is an extraperitoneal or an intraperitoneal one. Now that such great advances are being made in general surgery and exploratory incisions for the purpose of ascertaining the extent of an injury have become so common, together with the fact that skilful operators are becoming so numerous, it hardly seems necessary to divide injuries and rupture of the bladder into many different classes, each to be considered under a separate head. The most exhaustive work that has been done on this subject, according to the writers' knowledge, is recorded by Duplay and Reclus, "Traite de Chirurgie," vol. vii.

The bladder is rarely wounded in its anterior aspect, unless the organ is very much distended, for the reason that, when empty or only partially full, it is protected in front by the pubic bone. It is more often wounded as the result of a penetrating injury through the perineum, as from falling on a sharp substance; through the rectum or through the back, following the infliction of a stab wound, and occasionally from the toss of a bull. It is also not infrequently wounded during the performance of some abdominal operation, particularly during hysterectomy. Quite a large portion of the bladder-wall may be torn off either from the inside or as the result of injury outside of the bladder, the organ continuing to functionate and repair of the wound following.

Wounds of the bladder are very seldom uncomplicated, being almost always associated with wounds of some other organ. Experiments and observations on both experimental animals and on

[1] Harrison, Reginald: "Lancet," 1897.

man tend to show that nature very quickly attempts the repair of an injury to the bladder.

If the wound is situated intraperitoneally, adhesions from the peritoneum form very rapidly and tend to close it in. If extraperitoneally, it closes almost as rapidly. A considerable portion of the bladder substance may be removed and cicatrization and repair still go on. The folds of the wounded bladder tend to shut down on themselves and keep the urine from escaping through the wound.

Painful micturition, bloody urine, and shock are more or less constant symptoms of bladder injuries. Later, if the wound has been an intraperitoneal one, these symptoms may be followed by peritonitis or by symptoms of purulent cystitis. A fistula may subsequently be established. If the bladder is wounded during an operation and the wound is immediately sutured, ordinarily but little trouble follows. Infiltration of urine into the surrounding tissues may, however, follow infliction of the wound, and can generally be diagnosed by the swelling caused by such infiltration if the wound has been an extraperitoneal one.

The *treatment* of wounds of the bladder is as follows:

The hemorrhage should be checked, foreign bodies removed, and proper care observed, by the use of antiseptic measures and drainage, to prevent the after-formation of fistula. This can be accomplished by the introduction of a retention catheter or by making a perineal or suprapubic incision. In all doubtful cases of penetrating wounds of the lower portion of the abdomen an exploratory laparotomy is indicated.

RUPTURE OF THE BLADDER

Rupture of the bladder is probably somewhat more common than are wounds of the bladder. It may be the result of injury or of overdistention of a diseased bladder. Rupture has been known to follow overdistention due to the employment of too large a quantity of an irrigating fluid by the surgeon. It would be interesting to observe how many cases of rupture of the bladder occur in drunkards either from overdistention or from injury. Rupture of the bladder may occur either extraperitoneally or intraperitoneally, the latter being by far the most common. The

site of the rupture is generally at the back or at the bottom of the bladder. The rupture that occurs in fractures of the pelvis is more likely to be extraperitoneal. The rent is generally a vertical or an oblique one.

The symptoms of rupture of the bladder, like those of wounds of the bladder, consist of shock, which is particularly marked in those cases in which the rupture is due to some abdominal injury. In other cases the shock is not so marked. Tenesmus and hemorrhage are generally associated. If sought for carefully shortly after rupture a prevesical swelling will generally be detected—symmetric if it is intraperitoneal, asymmetric if it is extraperitoneal. A searcher introduced into the bladder may locate the rupture, as evidenced by the pressure made by the searcher against the hand on the abdomen. In intraperitoneal rupture very little urine can be obtained, the jet is diminished in volume, with feeble pressure under the movements of inspiration and expiration. Rupture of the bladder, particularly of the intraperitoneal type, if allowed to go untreated, is likely to be followed in four or five days by symptoms of general peritonitis. One hundred and seven cases of intraperitoneal rupture have been reported, of whom 82 died during the first five days. In those cases in which the rupture takes place extraperitoneally the symptoms of urinary infiltration are more numerous, and its increase is manifested by the extension of the prevesical swelling and the tendency of the infiltration to extend in other directions. More or less pain in the region of the buttocks is generally present.

Rectal examination may be an aid in diagnosing urinary infiltration. It is necessary to differentiate this condition from injury of the kidney, as the latter may also give rise to tenesmus and bloody urine. The searcher, associated with the rectal and abdominal touch, should be of considerable aid in making the differentiation. The prognosis will depend upon many different factors—the nature of the injury to other organs, the age of the patient, and many accompanying circumstances. As a rule, the prognosis is grave.

Treatment.—The treatment must necessarily be modified to suit the individual case. When doubt exists concerning rupture or injury of the bladder within twenty-four hours of the time of

the injury, an abdominal incision should be made and the bladder-wall examined. If an intraperitoneal rupture has occurred, it should be sewed up with catgut. The peritoneum should also be united with fine catgut or silk, the latter being used in preference to the catgut when there is fear that the former may be too rapidly absorbed before the opening has united. An ununited opening may give rise to peritonitis. The serous and muscular surfaces only should be sutured. The opening should then be closed, and a perineal section made for drainage purposes or a retention catheter should be put in place. If an extraperitoneal rupture exists, a suprapubic incision may be made, the condition of the walls of the bladder examined, and such after-treatment prescribed as the needs of the case may seem to indicate. If infiltration has taken place, this is manifested by the swelling about the gluteal region, thighs, perineum, and lower part of the abdomen. In such infiltrations incisions should be made through the skin and cellular tissue, and as many drainage-tubes, running in various directions, introduced as the character and number of such infiltrations require, in order that the skin and cellular tissue be drained as well as possible, otherwise troublesome sloughing will result; some is, nevertheless, bound to occur in any case.

There is one point to which attention must again be drawn, and that is as to the urgent need of performing early catheterization in persons found in an unconscious state from injury, drunkenness, or apoplexy. In a large series of these cases studied by the writers, overdistention was found to be the principal predisposing cause of cystitis. This series included some cases of unrecognized rupture of the bladder. Early catheterization, then, if sometimes performed on the unconscious, would reduce the number of cases of cystitis due to overdistention, and would occasionally permit an earlier diagnosis of rupture of the bladder to be made, thereby increasing the prospects of a favorable after-result.

TOTAL EXTIRPATION OF THE BLADDER

This operation is occasionally performed for extrophy of the bladder, as previously mentioned, or for the relief of patients suffering from malignant diseases of the bladder. It necessitates

the performance of a double nephrotomy, or that the ureters be transplanted into the intestine or the loin. In transplanting the ureters care must be used to see that the course of the ureter is not interfered with, and that no kinking results. The method of transplanting or making an anastomosis with the intestine has already been referred to. The operation of excision consists in making a long incision in the median line from the pubes to the umbilicus; at right angles to this incision, just above the pubes, an incision is made across each side as far as the external border of the recti muscle, so that the general shape of the incision is that of the letter T. The skin, muscles, and peritoneum are incised; then the bladder should be freed from the deep layer of the peritoneum on each side, in the following manner; the intestine having previously been pushed upward, a pair of forceps is put on the top of the bladder to pull it above the pubes; the peritoneum is then cut along the sides of the bladder, as far as the base of the bladder; a transverse incision then divides the peritoneum, just back of the posterior superior border of the prostate; the peritoneum is then stripped off the bottom of Douglas' cul-de-sac and the posterior aspect of the prostate. With the peritoneum are detached the seminal vesicles and the extremities of the vas. The bladder is now pulled forward on to the pubes, and the pelvic peritoneum is brought together by a vertical suture from the bottom of Douglas' cul-de-sac to the upper border of the abdominal incision; the remainder of the operation is extraperitoneal. The various ligaments are tied off, and the ureters are cut through. If the bladder be lifted up with considerable tension, the incision of the ligaments is rendered easier. The urethra is then incised in front of the neck of the bladder, the organ being pulled toward the umbilicus for this purpose. The bladder is then removed as a complete sac, the cavity is then drained and, if necessary, packed.

HERNIA OF THE BLADDER

Vesical hernia is generally associated with inguinal hernia, and manifests itself, as does the latter, by swelling in the groin. Very rarely it happens that a hernia of the bladder descends with intestinal hernia into the scrotum. The condition often remains

unrecognized until operation for the relief of hernia is performed. Occasionally it is very manifest, as is shown in the illustrations taken from Frisch and Zuckerkandl. If marked diminution in the size of the tumor is found to take place on urination, a diagnosis of bladder hernia can be made.

In operating for the relief of inguinal hernia, if protrusion of the bladder is also encountered, it should be freed from adhesions and returned to its place and the wound sutured. An attempt should be made to restore it to its former position even if all the adhesions cannot be freed. If a vesical hernia becomes strangulated, it may be necessary to open and drain. If the bladder hernia has formed a pouch so that urine that collects in it cannot be released from the bladder, it may be necessary to also open the pouch and drain. If the bladder is wounded during the operation for hernia, the incision should be sutured, the hernia of the

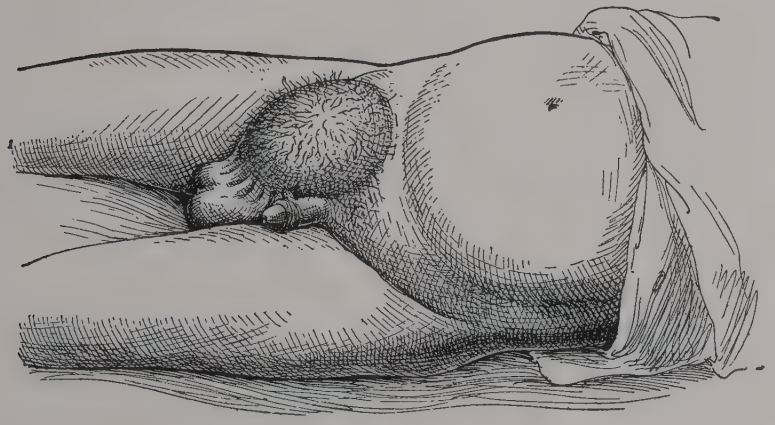


Fig. 167.—Hernia of bladder (Frisch and Zuckerkandl).

bladder replaced, and drainage instituted through the suprapubic incision by the perineal route or by a retention catheter.

The treatment of the case will depend to a great extent on the individual circumstances surrounding each case; it may, however, be summed up as follows: the return of the hernial pouch; when possible, the opening and draining of the bladder pouch, which will hasten the expulsion of retained secretions that cannot otherwise be voided, together with drainage of the bladder, when

necessary, by suprapubic or perineal incision. Resection of the bladder for hernia followed by suture of the organ has not as yet been demonstrated to be a successful operation.

DIVERTICULA OF THE BLADDER

These may not in themselves give rise to any characteristic symptoms, whether they are of the congenital or the acquired variety. The use of the cystoscope and instrumentation will generally render their diagnosis comparatively simple. Concerning their treatment, if there is no cystitis present, they can be allowed to remain as they are. If the bladder becomes infected, the effect of irrigations should be observed; if such irrigations are not sufficient to restore the bladder to a normal condition, it may become necessary to operate on the diverticula. The form of operation required will be indicated by the nature of the diverticula. A simple wall existing between the diverticula and the bladder can be removed by incision, and the whole cavity thrown into one. Other forms of diverticula will require complete removal and suturing of the bladder-wall.

Patent Urachus.—A patent urachus may be the seat of abscess and sometimes the point of origin of tumors and cysts. The cysts are generally retention in origin, according to Vaughan,[1] who has made a careful study of the matter. The different forms of patent urachus are discussed under the four headings:

(1) The complete, in which the duct is open all the way, forming a continuous communication between the bladder and the outside of the body at the navel.

(2) The blind internal, in which the navel remains closed, but the duct communicates with the bladder.

(3) The blind external, in which the communication with the bladder is closed, but the navel end of the duct remains open.

(4) The blind, in which both ends are closed, but the duct remains open in the middle.

Thirty-two out of fifty congenital cases were in men, the lesion appearing at birth or soon after the stump of the cord separated. The acquired cases, that is, those in which patent urachus subse-

[1] "Patent Urachus," "Transactions of the American Surgical Assoc.," 1905, vol. xxiii.

quently develops, may be of any age, the oldest reported, according to Vaughan, being seventy-nine. *Symptoms* vary according to the condition present; they may consist in having urine appear at the umbilicus, or pus, or the indication of formation of cysts. Patent urachus can be *diagnosed* with comparative ease if there is an exudation of pus or blood from the umbilicus; if a cystic

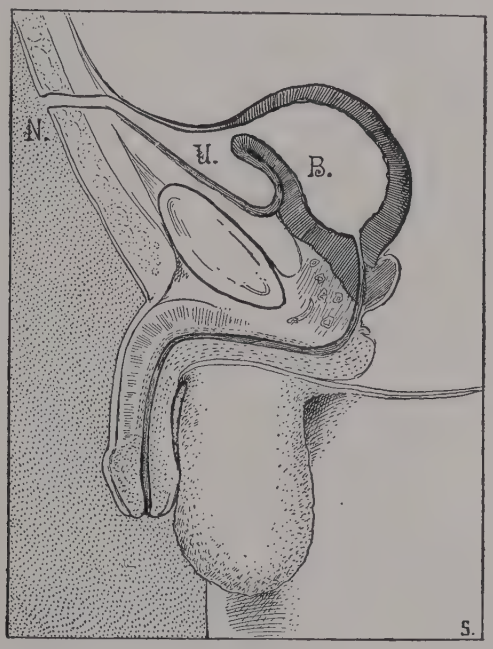


Fig. 168.— Patent urachus: *N*, Navel; *U*, urachus (dilated); *B*, bladder (after Vaughan).

formation exists, it may be mistaken for cysts due to other causes. If the umbilicus opening is closed, it may be diagnosed from cysts due to other causes by instrumental or cystoscopic examination of the bladder. *Treatment*, when possible, consists of extirpation, closure of the bladder opening with sutures and drainage, or in some cases the slitting up of the cavity and packing it.

CHAPTER XXI

THE ANATOMY OF THE PENIS AND MALE URETHRA

The *penis* is made up of four elemental structures. These are the corpora cavernosa, the corpus spongiosum, and the glans penis. Of these, the *corpora cavernosa* form the principal part. They are two cylindric bodies, placed side by side, flattened at their median aspect, and partly blended together in the median line in the anterior portion, but separated posteriorly, where they branch out into first bulging and then tapering masses; these are attached to the rami of the pubic bones, and are known as the *crura* of the penis.

Each corpus cavernosum is surrounded by a thick and very dense layer of fibrous connective tissue known as the *tunica albuginea*. The tunics of the corpora blend more or less in the median line, to form the *septum pectiniforme*, which is, however, not a complete septum, since in the anterior portion of the penis its continuity is broken, so that the substance of the corpora blends, to a greater or less extent, in the anterior portions. From the interior of the fibrous envelops and from the septum numerous lamellæ, bands, and cords composed of mingled fibrous and elastic connective tissue and of smooth muscle pass inward and run through and across the cavity in every direction, thus subdividing the corpora cavernosa into many interstices. The trabeculæ are larger and stronger near the periphery, and, conversely, the spaces are larger, and have thinner walls near the center. In general, the long diameter of these spaces is parallel to the long axis of the penis. These connecting spaces are lined by a layer of endothelial cells, and are directly continuous with the veins, so that they are in reality dilated, anastomosing venous spaces.

The corpora cavernosa receive their principal arterial blood-supply from the profunda penis arteries, the dorsal artery of the penis contributing a smaller amount. Inside the corpora cavernosa numerous arteries are carried within the trabeculæ; they

terminate in branches of capillary minuteness, which open directly into the intratrabecular spaces or the venous sinuses. Some of the arteries project into the spaces, where they present a peculiar contorted or curling aspect, and are therefore called the *helicine arteries*. The purpose of these loops or coils is probably to prevent the vessels from being torn when the organ becomes erect. Directly continuous with the venous spaces are the veins which convey the blood from them, emptying it into two sets of return trunks—those of the dorsal vein of the penis and those of the prostatic plexus.

The inferior portion of the united surface of the corpora cavernosa is marked by a longitudinal groove in which is lodged the *corpus spongiosum*, a cylindric mass beginning at the triangular ligament of the perineum, where it is placed midway between the crura. The posterior portion is enlarged into a bulbous dilation and extends forward as a somewhat tapering cylinder, until it reaches the anterior extremity of the corpora cavernosa, over which it expands into a large, conic mass, the glans penis.

Throughout its entire course the corpus spongiosum incloses and invests the male urethra and its special coats. The structure of the corpus spongiosum is essentially the same as that of the corpora cavernosa, but the fibrous framework is much less dense and the venous spaces are much smaller. These become congested in the erect state of the organ, but never to so marked a degree as do the sinuses of the corpora cavernosa. The blood-supply of the corpus spongiosum is derived from the two lateral branches of the internal pubic, which enters the body at the bulb and extends as far forward as the glans.

The *glans penis* is a conic enlargement of the corpus spongiosum which covers over the ends of the cavernosa and forms the anterior portion or cap of the penis. It is made up of a still more dense form of erectile tissue than is the corpus spongiosum, and is covered in by a thick mucous membrane of stratified squamous epithelium which is reflected over very numerous small papillæ of the connective tissue, beneath which are contained the special sense nerve-endings, the genital corpuscles. The glans receives its arterial supply from the dorsal artery of the penis, and returns its venous blood into the great dorsal vein.

The three cylindric bodies of the penis are united by somewhat dense encircling fibers of areolar connective tissue, which support the vessels, nerves, and lymphatics of the organ. Outside the encircling sheet of connective tissue there is a loose areolar layer of connective tissue, devoid of fat and uniting the skin to the penis.

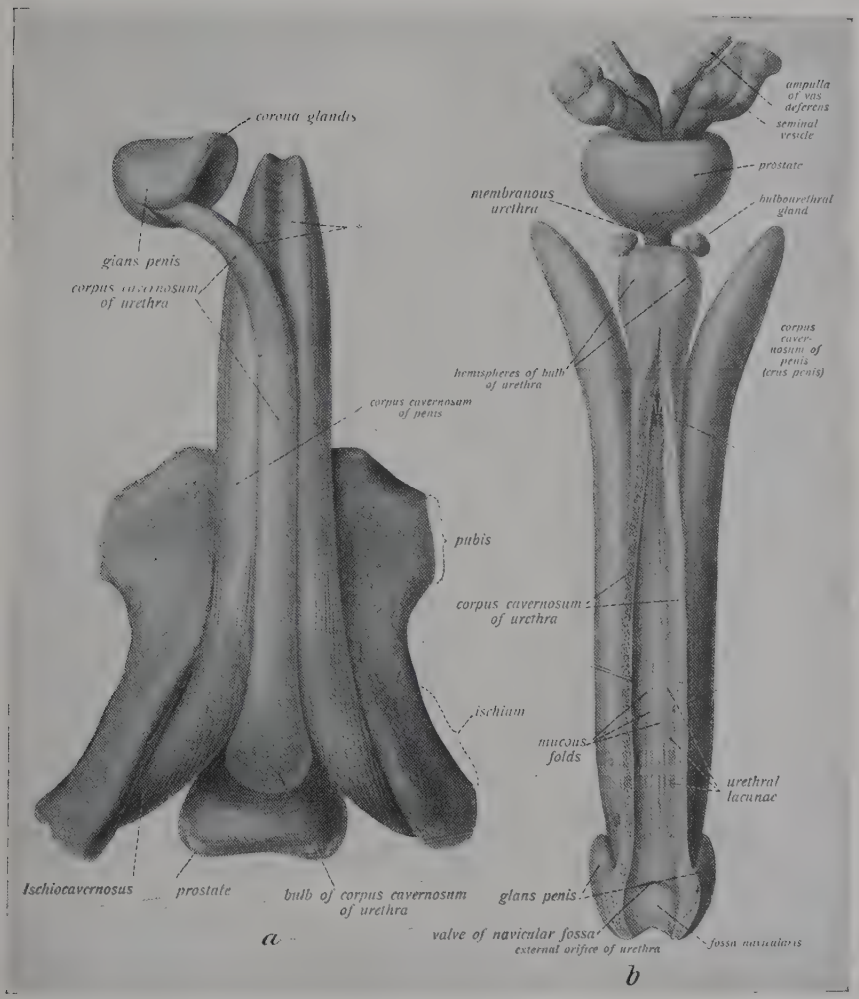
The skin covering the penis is characterized by its thinness, its freedom from fat, and its large venous and lymphatic supply. Its anterior portion is devoid of hair, and is prolonged over the glans as the foreskin, or prepuce, the internal surface of which is lined with a mucous membrane uniting the back of the corona with that which covers the glans. About the corona is situated a ring of large modified sebaceous glands called the *glands of Tyson*. These give rise to an odoriferous waxy secretion, which, mixed with the desquamated epithelial cells, forms the smegma.

The blood-supply of the penis has been sufficiently described elsewhere. The lymphatics form a dense network on the glans and foreskin, and also surround the urethra in the corpus spongiosum; they empty chiefly into the inguinal lymph-nodes, but some of the deeper trunks that supply the corpora join with the lymph tracts of the pelvis.

The *male urethra* presents a structure of considerable complexity, and to the physician who makes a specialty of diseases of the male genital organs its microscopic structure is of the greatest possible importance. It extends from the bladder to the end of the penis, a distance of about eight inches, varying according to the length of the penis and the condition of that organ. Its inner tube is lined by a continuous epithelial covering and normally its walls are collapsed and in contact, except during the passage of the seminal or urinary fluids. Anatomically the urethra may be divided, for purposes of description, into three portions—prostatic, membranous, and penile.

The *prostatic urethra* is that portion inclosed in the prostate gland. It is about 1¼ inches in length, and is wider than either of the other two portions. At about its center it presents a dilatation known as the *prostatic sinus*. The lining membrane is thrown into longitudinal folds, and is covered by a transitional epithelium continuous with that of the bladder. A few millimeters from the opening into the bladder there is a small triangular elevation of

PLATE XII



a, The corpora cavernosa of the penis: The glans penis and the anterior part of the corpus cavernosum of the urethra have been drawn aside. * = Points which are in contact when the parts are in their natural position. *b*, The male urethra with the corpora cavernosa of the penis, the bulbourethral glands and the prostate: The corpus cavernosum of the urethra has been opened by a longitudinal incision in its mid-ventral line. ** = Sounds in the orifices of the bulbourethral glands (Sobotta and McMurrich).

the mucous membrane known as the *verumontanum;* this acts as a valve that closes the entrance into the bladder and so serves to prevent return flow of the semen during ejaculation. On each side of the verumontanum the floor of the urethra is slightly depressed and perforated by numerous foramina, which are the ducts of the prostate gland; these discharge their viscid secretion into the urethra at this point. Just anterior to the verumontanum is the orifice of a blind pouch, the *sinus pocularis*, on whose edges are the slit-like openings of the common seminal or ejaculatory ducts. Into this pouch, as it extends backward for about half an inch, numerous tiny glands open. It is lined by columnar epithelium, and discharges its contents into the urethra. When this pocket is involved in inflammatory disease of the urethra, the condition does not respond readily to treatment on account of this anatomic structure. The walls of the prostatic urethra are made up of the firm tissue of the prostate gland, but at the point where the urethra unites with the bladder there is a well-developed circular band of smooth muscle—the so-called "cut off muscle."

The *membranous urethra* is that portion situated between the prostate gland and the bulb of the corpus spongiosum. It is about three-fourths of an inch long, and its anterior part is covered by the bulb of the corpus spongiosum; it is the narrowest portion of the urethra and is lined by stratified columnar epithelium. Its wall is made up of a vascular erectile areolar connective tissue, and of encircling fibers of smooth muscle that are continuous with those fibers that make up the muscular walls of the bladder. These are further augmented by the compressor urethræ muscle, which externally surrounds the membranous portion of the urethra. Into the anterior portion of the membranous urethra enter the ducts of *Cowper's glands.* These are two racemose glands, situated on each side of the membranous urethra, just back of the bulb. They are lined by clear columnar epithelial cells, and their basement membrane is made up of smooth muscle and areolar connective tissue. They secrete a clear viscid substance which is discharged into the membranous urethra.

The *penile or spongy portion of the urethra* is entirely inclosed by the erectile tissue of the corpus spongiosum; it is the longest

portion of the canal. In cross-section it is seen as a transverse slit running up to the glans, where it dilates into a spindle-shaped chamber called the *fossa navicularis*. This opens on the surface of the glans by a vertical slit, the *meatus urinarius*, which is normally the narrowest part of the entire urethral canal. The penile portion of the urethra is lined by simple columnar epithelium up to the fossa navicularis; there the lining consists of stratified squamous epithelium, which is a continuation of that of the surface of the glans. Numerous small tubular glands whose ducts open out into the epithelial surface are found throughout the entire course of the penile urethra—these are the *glands of Littré* and the *lacunæ of Morgagni*. They secrete a substance that keeps the mucosa of this portion of the urethra moist. The walls of the penile portion of the urethra contain no muscle tissue, but are made up of the epithelium and of a continuation of the connective tissue of the corpus spongiosum.

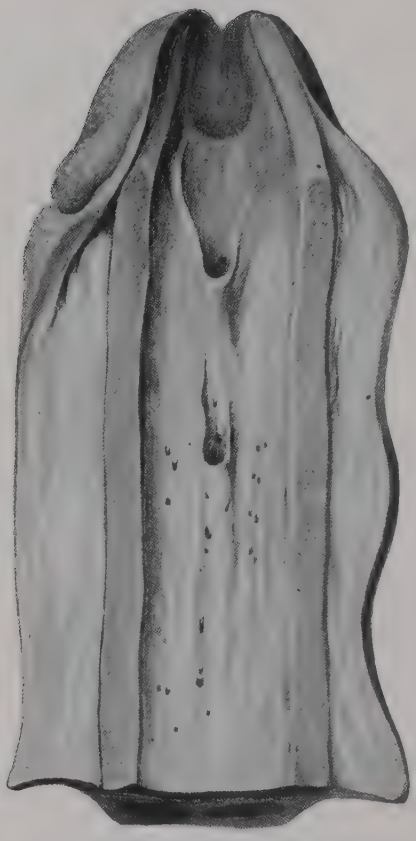


Fig. 169.—Longitudinal section through the urethra, showing the large lacunæ of Morgagni and the small glands of Littré (after H. Frantz).

CHAPTER XXII

DISEASES OF THE MALE URETHRA

URETHRITIS

Pathology.—Urethritis may, for descriptive purposes, be divided into two forms—the acute and the chronic; this division is capable of further subdivision, and of these the catarrhal and the purulent forms are most important. The condition is most frequently due to infection by the gonococcus, and hence it is the gonorrheal form with which we are chiefly concerned. In the clinical consideration of this disease the term urethritis is used somewhat generally to describe various forms of inflammation of the urethral canal, the term being applied to both those cases in which the gonococcus can and those in which it cannot be demonstrated.

Acute catarrhal urethritis results, as a rule, from the irritation set up by chemic substances excreted in the urine. The changes produced by this condition consist of a hyperemia of the blood-vessels of the mucosa, usually with more or less desquamation of the urethral epithelium, and a greater or less degree of leukocytic exudation and infiltration. When the condition is due to bacterial activity, it is usually succeeded by the development of acute purulent urethritis, under which heading these more important changes will be discussed. Owing to the stimulation of the irritant that produced the inflammation hypersecretion of mucus from the urethral glands takes place, giving to the exudate a char acteristic glairy and mucoid character. When infection follows catarrhal urethritis, particularly when such organisms as members of the proteus or colon group are present, chronic inflammation may follow.

Chronic catarrhal urethritis may occur as a sequel to prolonged acute catarrhal urethritis, but, as a rule, it more frequently follows suppurative and particularly gonorrheal urethritis. In these cases it is usually associated with stricture and with chronic

inflammation of the mucus-secreting glands. These changes will be discussed at greater length under the sequels of purulent urethritis.

Acute Purulent Urethritis.—Acute purulent urethritis may develop as the result of infection of the urethra by any virulent organism, or it may follow the application of an irritant to the urethra for medicinal purposes or the voiding of irritating substances in the urine. The gonococcus is by far the most frequent cause of urethritis, however, as seen by the practitioner. In the discussion of the pathology of urethritis, therefore, the aim will be to adhere to the changes that occur in this most frequent specific type of the disease, it being understood that the anatomic changes that take place in all the infectious forms are practically alike, varying in intensity according to the virulence of the infecting organisms.

Bacteriology.—For a proper understanding of the changes that take place in gonorrheal urethritis it is necessary first to consider briefly the biologic characteristics of the gonococcus, for it is by certain of these qualities that the virulence of the disease and its treatment are considerably modified. Perhaps the most important of the biologic characteristics of the gonococcus is its almost strictly parasitic nature, as a result of which the organism cannot live for any considerable length of time except in living animal tissues or in carefully prepared artificial media that closely simulate them. As a further result of this parasitic character, which is further confined to man and the higher apes, gonorrhea is transmitted almost always directly from subject to subject. The organism soon dies when out of the body even when present in moist discharges on infected clothing, so that cases of secondary infection by this means are probably rare. Nevertheless this mode of infection may be sometimes held responsible for the epidemics of gonorrhea seen in children's hospitals. A further characteristic of the organism is its predilection for the mucous and serous surfaces, although hemic infection, as in gonorrheal endocarditis or septicemia, occasionally takes place. No toxins or antitoxic bodies are formed by the gonococcus; and immunity, either natural or acquired, in man is a most unusual condition. This statement must, however, be somewhat modified by the fact

that, under certain circumstances, prolonged exposure to a definite strain or culture of the organism confers a degree of resistance toward it, as is well shown in certain cases of gleet. This peculiarity is noticeable in cases in which, infection having taken place, continued exposure does not result in the breaking out of the infection in one or the other, although either subject would be capable of transmitting it to a third person; if, however, a fresh infection is introduced, active acute inflammatory changes develop.

A predisposition to gonorrheal infection undoubtedly exists in many cases, but, in most instances, this is a direct result of conditions facilitating primary inoculation, such as, for example, abrasion or fissure of the exposed epithelial surfaces; simple inflammatory conditions induced by a highly acid urine or by the excretion of alcohol and other chemic irritants.

Mode of Infection.—Under normal conditions the epithelium of the fossa navicularis, so capable of obviating bacterial infection, does not permit infection with the gonococcus to take place in this portion of the urethra. If, however, from any cause this surface is eroded or fissured, infection quickly follows. Close clinical observation apparently demonstrates that in many cases the gonococcus may remain in the fossa navicularis for a considerable period of time, and may even reproduce in this portion of the tract, without exciting marked inflammatory reaction. If, however, the organism gains access to the pendulous portion of the urethra, either by direct extension from the fossa navicularis or by being drawn backward by the aspiratory action said to follow relaxation of the bladder or of the extrusor muscle, acute inflammatory reaction almost immediately takes place. These facts have been amply proved by the experimental inoculations of Finger, who showed that gonococci will not penetrate the healthy squamous epithelium of the fossa navicularis under normal conditions, although infection quickly follows the implantation of infectious material on the columnar epithelium of the pendulous portion.

Pathologic Anatomy.—Finger found that three days after infection the mucous membrane was covered with a copious purulent secretion and that the epithelial layer was extensively infiltrated with pus-cells, which, on examination, showed that

abundant gonococci were present. The lumen of the urethra contained quantities of mucus rich in gonococci. The inflammatory reaction had extended into the tissues of the corpus spongiosum, which showed also purulent infiltration and round-celled proliferation, although gonococci were but rarely found in the deeper layers.

The glands of Littré become extensively involved, the infection apparently traversing the duct of the gland down to the deep-lying acini, where local inflammation, often terminating in abscess formation, takes place. Later marked desquamation of the urethral epithelium occurs, and the mucous membrane, as seen through the urethral coat, appears studded with minute ulcerations, usually situated about the openings of the urethral glands. Thrombosis of many of the submucous blood-vessels takes place, and may extend into the erectile sinuses of the corpus spongiosum or even into those of the corpora cavernosa, giving rise to chordee, which is due to the irregular distention of the erectile spaces when the penis becomes engorged.

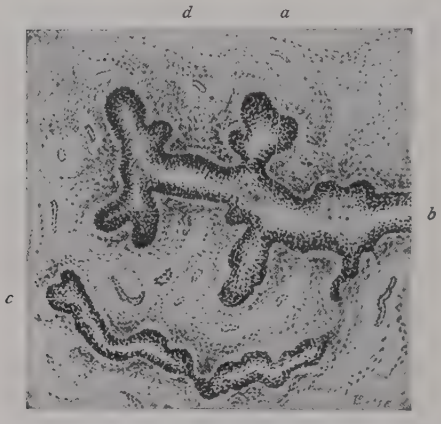


Fig. 170.—Acute gonorrheal urethritis involving the pendulous urethra; eight days after infection: *A*, Urethra; *B*, desquamated epithelial cells; *C*, body of a gland of Littré; *D*, inflammatory infiltration of tissues about urethra.

In a certain number of cases of acute urethritis the infection may not extend to a point back of the pendulous urethra, although from anatomic researches, the writers are convinced that, as a rule, the entire channel finally becomes more or less involved. In favorable cases healing may take place by an absorption of the inflammatory exudate, the epithelium reforming, covering the excoriated areas with a layer of new epithelial cells that are no longer columnar, but of the simple squamous type. Inevitably, cicatrices of greater or less degree are formed in the submucous connective tissues following the absorption of the inflammatory

exudate, resulting in conditions that will be discussed further on under the head of Stricture.

One of the most frequent sequels of acute specific urethritis is abscess formation in one or more of the glands of Littré. The duct may become occluded, thus tending to localize the process, whereas the exudate in other portions of the urethra may entirely disappear. Acute reinfection may follow the rupture of such an abscess, or, in a certain number of cases, rupture through the capsule of the corpus spongiosum and external drainage, with the formation of urinary fistula, may follow. There can be no question but that many cases of reinfection follow this autoinoculation in what are apparently cured cases of gonorrhea.

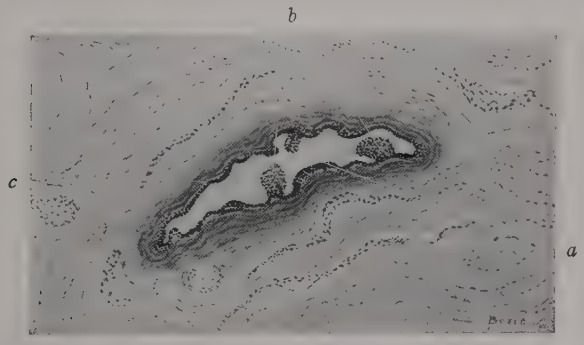


Fig. 171.—Chronic stricture of the posterior urethra showing granulomatous masses projecting into the channel and explaining the persistence of urethral discharge in these cases. *A*, Urethra; *B*, granulomatous masses projecting into urethra; *C*, scar tissue formed about urethra as a result of chronic inflammation.

When the infection extends into the posterior urethra, an extension may occur from the membranous portion into the glands of Cowper and into the prostatic urethra, through the ducts of the prostate gland into the acini, where suppurative prostatitis may be set up. Similarly, the infection may involve the sinus pocularis, and, through the ejaculatory ducts, the vas and seminal vesicles, in this way often reaching the epididymis and testicle. Diffuse abscess formation may follow this extensive area of infected mucous membrane, and occasionally terminate in gangrene involving the entire penis. It should be remembered that the extension and character of the later anatomic changes are largely dependent on secondary infection, and in long-standing cases

the gonococcus may even disappear entirely, having apparently been superseded by secondary organisms, chiefly of the proteus and colon varieties.

Strictures of the urethra are among the more frequent complications of gonorrheal urethritis. They may occur in any portion of the tract, although in the writers' experience they have been found to occur most often in the membranous urethra. They result from the hyperplasia of the submucous connective tissue that follows the acute inflammatory changes, or that ensues as the result of physiologic attempts at repair where loss of tissue, as from abscess formation or thrombosis with necrosis, has taken place. If this occurs about or near the urethra, more or less obstruction inevitably follows, the extent of which depends entirely on the degree and location of the scar tissue. The epithelium covering the urethral surface may be entirely absent, or, if present, is of the simple squamous and atypical variety.

When these obstructions to the urethra exist, proper drainage is no longer possible, and chronic inflammatory exudation almost always follows, giving rise to the discharge of a thin, watery secretion that contains a few pus-cells, desquamated epithelium, and, in an acute exacerbation of the inflammation, blood-cells and pus in larger quantities. This exudate is usually rich in bacterial growth, and is more or less highly infectious, although the gonococcus itself may be absent from it. It may be remembered that cicatrization of greater or less extent occurs in all cases where loss of tissue has taken place or inflammation of long standing existed; but the degree of urethral strictur that results is dependent not so much on the extent of this process as on its location. Extension of the inflammatory process to the bladder has been discussed under the head of Cystitis.

Symptoms of Urethritis

It is customary at the present time to make a classification of the disease according to whether the inflammatory condition extends beyond the bulbomembranous juncture or remains entirely within the pendulous urethra, two varieties being named—anterior and posterior urethritis. Such inflammatory conditions may be either acute or chronic. Thus we have acute anterior and

acute posterior urethritis, and chronic anterior and chronic posterior urethritis.

When acute inflammation exists in the posterior urethra, the anterior urethra, as a rule, is also involved; therefore when acute posterior urethritis is present, a general urethritis may ordinarily be said to exist. It may easily be demonstrated that in a large majority of cases—probably in all—urethritis involves the posterior urethra. It is the custom with many, however, to consider clinically as either acute or chronic anterior urethritis those cases in which the symptoms are not urgent enough to indicate much involvement of the posterior urethra.

Symptoms and Course of Acute Anterior Urethritis.—The period of incubation after infection has taken place and before any marked discharge occurs from the anterior urethra is from one to six days. During this period no clinical symptoms of which the individual is cognizant may be manifest, or there is a slight burning sensation, an itching, or a feeling of moisture. The first discharge that appears is mucous in character; later it becomes mucopurulent, in a few days more frankly purulent, and occasionally bloody. Ordinarily there will be considerable pain and burning on micturition; the mucous membrane and the meatus become swollen; micturition increases in frequency, and painful erections occur, particularly at night; attacks of chordee are usually frequent and extremely painful, and the acute stage of urethritis, generally of gonorrheal origin, may now be said to be fully established.

After a period whose length depends, among other things, on the constitution of the individual and on the treatment instituted, the discharge diminishes. It is, as a rule, more profuse in the morning than at night, and subsequently becomes mucopurulent in character. Ordinarily, in untreated cases, the change from the markedly purulent to the mucopurulent character takes place in from the third to the fourth week. After the discharge has become mucopurulent it gradually diminishes in quantity and eventually disappears; usually, in cases that do well, this occurs in from four to eight weeks. Relapses, however, are very likely to occur, and a subacute condition may be brought about in which a somewhat profuse mucopurulent discharge that may

remain for weeks and months may be present. Or, what is still more frequent, a single drop of discharge may be emitted in the morning; this is indicative of that condition of the mucous membrane of the urethra that it has been the custom, in the past, to designate as gleet—in other words, a chronic inflammatory condition exists.

Symptoms of Chronic Anterior Urethritis.—The general symptom, then, of chronic anterior urethritis is the persistence, for many weeks and months after the acute inflammatory condition has passed away, of a mucopurulent discharge of the morning-drop variety previously mentioned, or of the appearance of a large number of shreds from the anterior urethra. This inflammatory state may depend on several causes, combined or individual, such as unhealed erosions, granulomata (so-called softs strictures), or infection of some of the urethral glands.

Symptoms of Acute Posterior Urethritis.—The clinical symptoms believed to be diagnostic of acute posterior urethritis are frequent micturition at night, severe tenesmus, often a marked diminution of the discharge from the anterior urethra, bloody urine, occasional drops of blood exuding from the meatus, pain at the end of the penis, more or less uneasiness in the perineum or rectum, and generally some rise in temperature.

Symptoms of Chronic Posterior Urethritis.—This condition is frequently associated with chronic anterior urethritis and also with chronic prostatitis, in either of which conditions the symptoms indicative of the complicating disease would naturally be expected to be present. When not associated with the conditions mentioned, its most frequent symptoms are increased frequency of micturition at night, uneasy sensations at the end of the penis, in the perineum, or in the rectum, a feeling of moisture, a burning sensation after urination, pain in coitus, or indications of sexual neurasthenia.

Diagnosis

Recently much exhaustive work has been done to devise various methods for the more accurate diagnosis of the conditions previously mentioned. Hugh Young,[1] under the title of the

[1] "Johns Hopkins Hospital Report," 1906.

"Seven-glass Test," has made an investigation of the various glass tests that are in vogue, and has a modification of his own, which is as follows: He uses in this test a urethral irrigation tube made of glass, with a rubber cup made from half a small ball at a point about ten centimeters from the urethral end. "The patient is instructed to compress the urethra between the thumb and finger far back at the root of the penis (at the suspensory ligament); the irrigating tube is then slowly inserted, with the water running, up to the point of compression (suspensory ligament), and the fluid escaping is caught in two glasses, the first containing shreds, if any be present, and the second is clear (showing through cleansing). Then the patient's fingers are removed, and the tube carried back as far as the deeper part of the bulbous urethra, the urine again being caught in two glasses, the first containing shreds from the bulbous urethra and the second is clear as before.

"The patient then voids his urine in three glasses, as in Kollmann's test.

"Besides being far simpler, owing to the use of the lavage tube and cup in place of a catheter, the differentiation of the pendulous and bulbous portions of the urethra afforded has proved not only of considerable interest, but often of great importance in locating the lesion, and directing the character and extent of treatment necessary."

The Kollmann test referred to consists in collecting the urine in three glasses after the anterior urethra has been irrigated and the washings caught in two glasses.

We have already, in the chapter on the General Examination of the Patient (page 31) referred to some of the glass tests now commonly used for the purpose of diagnosing what part of the urethral canal is involved by the inflammatory process. When the urethra is in a state of very acute inflammation, with a very profuse yellowish discharge from the meatus, it is unwise to wash out the anterior urethra for the purpose of diagnosis through any instrument whatever, whether the instrument be so long that it will extend to the region of the bulb, or whether a short nozzle alone is used. For any degree of discharge less than the very acute one just mentioned we have found the very small olive-pointed gum catheter the most useful. It should be so small that it

will not occlude the meatus to such an extent, but there will be a free flow of the fluid out from the meatus along the side of the catheter. It should be introduced with the utmost gentleness as far as the region of the bulb, and four to six ounces of normal salt solution should be injected through it with as little force as possible. The water should be allowed to run as the instrument is removed from the urethra. The washings can be collected in glasses, as in the method of Kollmann or Young. The patient should then be allowed to urinate in three separate glasses. If the urine is clear in all three, it will be fairly good evidence that no acute inflammatory process at least exists beyond the compressor urethræ muscle. If the urine is cloudy in the first glass, or contains shreds in the first glass, it will indicate that the posterior urethra is affected, and that an acute posterior urethritis, with or without a prostatitis, exists. If all three glasses are cloudy, it will indicate that a cystitis or some inflammatory lesion beyond the compressor urethræ muscle exists. If the first glass is cloudy, the second glass is clear, and some slight cloudiness is present in the third glass, it will probably indicate some inflammatory condition of the prostate, the discharge from which is squeezed out by the contraction of the muscular fibers at the end of urination.

Concerning the diagnosis of chronic urethritis, if the patient complains of a morning drop, or that he has shreds in the urine, the anterior urethra should be washed out in one of the ways suggested, and if no shreds are found in the three glasses passed, it is very good evidence that the shreds do not come from the posterior urethra or the prostate. If, after washing out the anterior urethra, shreds are found in the first glass, it indicates that they come from the posterior urethra or the prostate. If the second glass is clear and shreds are found in the third glass, it would indicate that they came from the prostate. The character of the shreds also is somewhat of an indication as to the place from which they originate. The long fluffy shreds are ordinarily from the anterior urethra; the small hammer-shaped shreds from the prostate.

The diagnosis of chronic anterior urethritis, as previously mentioned, and its nature can be made out by direct inspection

through an endoscope, by the use of the bougie à boule of varying sizes, by the sensation to the touch through the passage of an olive-pointed bougie. It generally depends upon a granuloma, that is, an inflammatory infiltration, or the involvement of some of the glands of Littré or the crypts of Morgagni. Almost all cases of chronic anterior urethritis are associated with chronic posterior urethritis to a greater or less extent.

The diagnosis of chronic posterior urethritis, in addition to the information furnished by the various glass tests mentioned, can be aided by the passage into the bladder of an olive-pointed bougie for the purpose of observing whether a stricture may be present or not. The posterior urethra may also be observed under direct inspection through a long endoscopic tube, and the appearance of the colliculus should be particularly noted. In addition to this, information is afforded by examination with a steel instrument in the bladder and the finger in the rectum. The diagnosis of prostatitis, which almost always accompanies posterior urethritis, is referred to in the chapter dealing with Diseases of the Prostate. It is hardly necessary to state in detail here the various causes besides the gonococcus which may give rise to the urethral discharge. It may be associated with, or follow, fevers, it may be due to stricture, calculi, the presence of parasites, and various other organisms, such as the pneumococcus, it may be traumatic, or associated with gout or rheumatism. The secretions should be examined microscopically before any positive diagnosis can be made. The Gram stain will demonstrate the gonococcus if present in the secretion in the vast majority of cases. Culture tests for the gonococcus we have found to be too uncertain for routine use.

For further information concerning details of diagnosis the reader is referred to the chapter on Examination of Patients and Examination of Exudates.

Treatment of Non-gonorrheal Urethritis

The treatment of the various forms of non-gonorrheal urethritis necessarily is the treatment of the condition which is the causative factor of the case. If a slight discharge is due to a stricture, dilatation of the stricture and the proper treatment will cure the

discharge. If due to irregularities in the diet, proper hygienic measures should be executed. A discharge occasionally seen, in which no gonococci can be found by the microscope, but which is due to infection with simple pus micro-organisms, should be differentiated from a discharge of similar general appearance due to irritation of some previous existing chronic lesion of the urethra. If the latter is not present and the discharge persists, local treatment by irrigation with the Ultzmann injection, or nitrate of silver 1 : 10,000, used three times weekly, should be instituted. Such discharges ordinarily quickly stop under the appropriate treatment.

The Abortive Treatment of Urethritis

Before entering into a discussion as to the proper treatment of acute anterior urethritis, the methods now in use for aborting a threatened attack of the disease must be considered. Various lines of treatment intended to serve this purpose have been suggested and tried for many years past, but too many factors had to be considered to render statistics as to the benefit to be derived from certain procedures of any value.

The following method has for many years past been occasionally used by the writers. Recently we have learned of a method that is somewhat popular in Germany; for the description of this we are indebted to Dr. Henry H. Morton, of Brooklyn, N. Y.

Authors' Method.—If possible, before the gonococci have invaded the urethra and before the discharge has become frankly purulent, it is the writers' custom, in certain cases, to inject as large a quantity of glycerin as possible into the anterior urethra, compressing the meatus; the latter is then allowed to open, and a small pledget of cotton wrapped about the end of a wooden applicator, and moistened with silver nitrate solution of the strength of ten grains to the ounce, is introduced through the meatus and the outer two or three inches of the urethra painted. This application should not be made through an endoscope, for, in the writers' experience, the endoscopic tube proves irritating to the urethra. Under ordinary circumstances, the application should not extend beyond the first two or three inches of the urethra. The active inflammation set up by the silver nitrate should be counteracted externally by

applying cloths wrung out of hot water, and internally by the administration of potassium bicarbonate and hyoscyamus, which will render the urine unirritating. Not more than one application should be made daily, and if, after three applications, no beneficial results ensue, the treatment should be discontinued. If good results are apparent, the treatment should be continued at gradually increasing intervals until six or eight applications in all have been made. Clinically, in the writers' experience, this method seems most useful in cases of relapsing acute urethritis in which a chronic inflammatory condition has previously existed.

German Method.—If the patient is seen in the first three days before the discharge is active, and the microscope shows the presence of epithelial cells and leukocytes together with the gonococci, most of the latter being extracellular, the following procedure may be adopted in an effort to abort the disease. If, however, the gonococci are very abundant and intracellular, the method is contraindicated.

A microscopic examination of the secretion from the meatus will demonstrate whether or not an attempt at aborting the disease should be made by this method. When the effort is to be made, this is best done by irrigating the entire anterior urethra with a freshly made solution of albargin, 1 : 1000. Occasionally, in such cases, the patient is also directed to repeat the injection himself three or four times daily. Each time that the albargin is used a fresh solution should be made; for this purpose the albargin tablets are most convenient. If, after five or six days, a cure seems to be established, a provocative injection of silver nitrate may be used and any discharge that appears afterward examined to see if gonococci are still present. If they are found to persist, the abortive treatment may be considered to have been a failure. If, as the result of the abortive treatment, pus still appears and the gonococci have disappeared after five or six days, the albargin irrigation should be discontinued and irrigations of potassium permanganate substituted.

In addition to the local abortive treatment, the originator of the foregoing method also prescribes gonosan internally. There is danger, in almost all forms of abortive treatment, of giving rise to epididymitis, and also to other complications of urethritis.

From a study of fig. 160, which portrays a patient who died of pneumonia while suffering at the same time from an acute urethritis, it will be seen that the inflammatory condition extended into the follicles of the urethra and the glands of Littré. From a pathologic point of view, therefore, it would be impossible to cure a urethritis by means alone of local injections and irrigations confined to the anterior urethra; nevertheless this early local treatment, unaccompanied by the use of any other remedial measure, is still very popular.

As the result of the writers' pathologic investigations and clinical experience, amply substantiated by some of their associates, they are convinced that it is better to postpone the active local treatment of urethritis until after the acute stage has passed and the discharge first becomes mucopurulent; this is generally about the fourth to the sixth week after the onset of the disease. It may be said, however, that many conscientious and able surgeons hold a different view as regards the treatment of acute anterior urethritis; in acute posterior urethritis, on the other hand, almost all agree that active local measures should not be undertaken. Those who favor the early local treatment do not directly dispute the fact that most, if not all, cases of anterior urethritis are accompanied by coincident posterior urethritis; nevertheless they differentiate clinically, more than pathologically, between the two conditions, diagnosing as acute anterior urethritis those cases in which painful and increased frequency of micturition at night, and various other symptoms that are characteristic of acute posterior urethritis, are absent. In outlining any early local treatment to be pursued for acute urethritis, therefore, that method of local treatment that appeals most strongly to the writers has been described, although, as previously stated, they consider is wiser to postpone all local treatment until after the acute stage has passed.

Treatment of Acute Anterior Urethritis

The medicinal treatment of acute urethritis has been so extensively dealt with that most physicians are familiar with it. If no attempt is made to abort the disease and the patient is seen at the beginning of the attack or when the acute stage is at its height,

he should be induced, when possible, to remain in bed, and a diet consisting largely of milk should be prescribed. He should be instructed as to the great necessity for observing cleanliness, and should be informed of the serious danger to vision that follows infection of the eyes with the discharge. The necessity for observing personal cleanliness, particularly in respect to the parts that are concerned in the trouble, should be pointed out to the patient. This is best accomplished by means of bits of cotton, or, better still, pieces of gauze, through which a hole has been cut for the insertion of the glans, and the foreskin being pulled down over it, a new piece being applied after every urination. Coitus should be interdicted, and he should be warned against the excessive use of tobacco. All alcoholic, malt liquors, and wine should be forbidden. Strawberries and particularly asparagus should be avoided. If the patient cannot be prevented from moving about, a diet as light as is consistent with his condition and occupation should be recommended. A suspensory bandage should be worn. If possible, the patient's blood should be examined, for the presence or absence of various forms of anemia or of the malarial plasmodia. The nature of the disease and the pathologic condition that exists should be carefully explained to the patient, even at the expenditure of considerable time on the part of the surgeon. At times a simple pencil sketch of the anatomy of the neck of the bladder will help to make matters clear to the patient. The writers have almost invariably found that when the patient's condition is fully and patiently described to him, he becomes more submissive and more amenable to treatment. Once persuaded that it is the desire of the surgeon, after the acute symptoms have subsided, to restore the urethral canal to complete health, patients are, as a rule, willing to forego any desire they may previously have had for quick and powerful local treatment. It has been the writers' experience that if such explanations are made, the fear entertained by many practitioners that unless they do not immediately adopt local measures their patients will leave them, is groundless. As a general rule, the small minority who do seek the advice of another practitioner are very likely to return later on with one of the complications of urethritis, which renders them much more ready to resume treatment.

For the relief of the painful micturition the following well-known prescription will be found beneficial:

℞. Tinct. hyoscyami..... ℥ss.
Potassi bicarb..... ℥j.
Aquæ ..... ad ℥viij.
Sig.—Tablespoonful in water three or four times daily.

For the relief of chordee or painful erections camphor or the various preparations of the bromids may be prescribed. Cloths wrung out of cold water may also be applied with benefit. Cold sitz-baths have been advocated, but great caution should be exercised in their use, particularly by those who are feeble or infirm, for they are not infrequently followed by attacks of neuralgia.

Casper advocates the use of fluidextract of pichi, and prescribes it mixed with equal parts of balsam of copaiba and oil of sandalwood, flavored with oil of peppermint. This mixture is given in doses of 20 drops three times a day. He believes that pichi is useful for the relief of tenesmus. While this may be so, in a series of experiments carried on some years ago for the purpose of observing the effects of pichi in diminishing the discharge, the writers found no particular effect follow its use. Casper also recommends that tea be taken frequently during the day, presumably for the astringent effect of the tannin.

In the declining stages of acute anterior urethritis good results follow the internal administration of dram doses of fluidextract of hydrastis (golden-seal). Benefit may also be obtained from the following capsule:

Urotropin.....gr. ij.
Oil of sandalwood,
Oleoresin of cubebs,
Copaiba,
Oil of nutmeg, ...of each, ♏iij.

One of these capsules should be given three times a day. Gonosan capsules, which have been advocated in this disease, consist of kava-kava and oil of sandalwood, of each, 3 decigrams; two of these capsules are to be taken three times a day. A tea made of uva ursi is useful for relieving the irritation at the neck of the bladder. Triticum repens may also be of service. The fluidextracts of saw palmetto and of buchu, of each a half teaspoonful two or three times a day, may be of benefit. When possible,

patients should be seen at least once weekly, and oftener if the indications of the case demand it. If no local treatment has been given, at the end of about from four to six weeks the discharge begins to decrease in volume or lose its yellow tinge, or both, the process tending to become subacute or chronic. If the surgeon was not decided as to the best time to begin earlier local treatment, it may now, if deemed advisable, be instituted in a tentative manner, or the patient may be kept under close observation, and if he does well, the discharge gradually subsiding and finally ceasing altogether, the urine becoming clear, and if there are no other indications pointing toward any continuation of the disease, the patient may be discharged without receiving local treatment. It is well, however, to inform him that his condition was a serious one, the results of which may become manifest in after-life, and he should, therefore, be advised to visit the physician occasionally so that any after-effects may be detected.

In acute anterior urethritis in those cases in which most of the effects of the disease are evident in the anterior urethra, some advocate the passage of a sound into this portion of the urethra, the discharge diminishing very considerably at the end of about the fifth week. This may be repeated at intervals of from once a week to once in five days, the amount of secretion being the guide as to the frequency with which the instrument should be passed. Instead of a sound, a Kollmann anterior dilator may be used. This procedure is to be followed in three days by irrigation with silver nitrate, 1 : 10,000, or ichthargin, 1 : 4000. Patients may at the same time use an injection of zinc and resorcin.

Early Local Treatment of Acute Anterior Urethritis.—As has previously been stated, the writers deem it advisable, certainly in the majority of cases, to postpone the local treatment of the urethra by means of irrigations or injections until the discharge begins to assume a mucorpurulent character, relying for the time entirely upon proper hygiene, the alkalis, balsams, or herb teas, as previously mentioned. For those who desire, however, to begin local treatment earlier, the following methods are suggested.

One or two grains of albargin to 5 ounces of water may be used as an injection by the patient four times a day; it is to be retained

for five minutes. Protargol one per cent. may be used in the same manner. If, in the course of about three weeks, the microscope demonstrates the presence of epithelium but the absence of gonococci, a different injection should be prescribed. The microscopic findings at this time should determine the changes to be made in the injection. If gonococci disappear, an injection, as mentioned above, may be used twice a day, alternating with the following: zinc sulphate one gram, resorcin two grams, water 150 grams. The patient should then receive an injection of this liquid twice a day, and the albargin injections should be limited to two a day. Gradually the albargin is dispensed with and only the zinc and resorcin mixture is used. After the discharge has ceased and threads from the anterior urethra alone remain, the patient may use silver nitrate injections, 1 : 10,000, or injections of ichthargin, 1 : 5000.

It should be remembered that in the ascending stage astringent injections will only tend to further seal up the gonococci which have already deeply invaded the tissues. The theory is that through the use of non-astringent germicidals, such as the various albuminate of silver salts,—albargin, protargol, or argyrol,—if not used in too irritating a form, the gonococcus is destroyed. In properly selected cases, under such treatment as outlined above, at the end of three weeks, the gonococci should have disappeared, or to have commenced to disappear from the secretion. Then the astringent substances mentioned should gradually come to be used until the discharge has almost entirely ceased. The gonococci having disappeared from the discharge, the various astringents having then been used and the discharge still persisting, the injections should be changed, and one of oxycyanid of mercury 1 : 4000 substituted. Then if the discharge still persists to any considerable extent, the patient is probably suffering from overtreatment and all local measures should be stopped, while the patient is still kept under observation, or posterior urethritis may be present to such an extent as to prevent the cure of the anterior urethritis. A certain amount of posterior urethritis is not considered by the originators of the above form of treatment to counterindicate it as a method for the treatment of acute anterior urethritis. They do not refrain from instituting this

form of treatment if the various glass tests show the posterior urethra to be only slightly involved, if no other clinical evidence of the involvement of the posterior urethra exists, such as fever, pain in the perineum, blood in the urine, or excessive tenesmus is present. They claim that through this method they diminish to a considerable extent the proportion of cases which become attacked by severe posterior urethritis. In carrying out this early local treatment the prostate should be frequently examined, and if it becomes swollen or tender, all local treatment should be stopped. The microscope should be regularly brought into use for the purpose of examining the secretions, and the injections should be modified according to the findings in the manner suggested above. The above method has been presented, in an amplified form, in a recent edition of a work by our friend, Dr. Henry H. Morton.[1]

Treatment of Chronic Anterior Urethritis

Chronic anterior urethritis only may be said to be present when the diagnostic methods described show that the posterior urethra is in a healthy condition, but a slight amount of purulent discharge, generally of the morning-drop variety, persists at the meatus or there is an abundance of threads or slightly purulent urine.

Treatment consists of injecting, as far as the bulbomembranous junction, a weak solution of silver nitrate, 1 : 10,000, or the Ultzmann injection, of phenol, alum, and zinc sulphate. If the condition still persists, an endoscopic examination should be made, for the chronic inflammatory state is, as a rule, due to the presence of some granulomatous infiltration about one or several of the urethral glands or to commencing stricture. If conditions permit, the inflamed area should be painted through the endoscope with silver nitrate solution or with some other suitable astringent; or the treatment may consist of destruction of the diseased glands by electricity, or of dilatation of the anterior urethra. These conditions are almost invariably associated with more or less chronic posterior urethritis, the proper treatment of which will, at the same time, tend to heal the inflamed area in the anterior urethra.

[1] "Genito-Urinary Diseases and Syphilis," 1906.

There seems to be marked agreement among those who have observed the effect of the silver salts that they are most useful in hastening elimination when gonococci are present if applied in dilute form; and that for a purulent discharge when gonococci are absent, or present only in small numbers, solutions of potassium permanganate, of resorcin, or of zinc sulphate are of benefit; for cleaning and disinfecting purposes, salt and water, boric acid, and solutions of the mercury oxycyanid, 1 : 4000, are efficacious. The writers firmly believe in the efficacy of the old-time injections of phenol, zinc sulphate, and alum, of each, 1 : 1000 to 1 : 500, as the exigencies of the case may demand, particularly when doubt exists as to whether the proper time for instituting local treatment has arrived. The local treatment just outlined for chronic anterior urethritis, if injections or irrigations are used, may be carried out once daily or oftener at the surgeon's office, using an irrigator, if desired, that does not penetrate far beyond the meatus; of these there are many forms on the market. The patient may also use a hand injection, if this is deemed advisable.

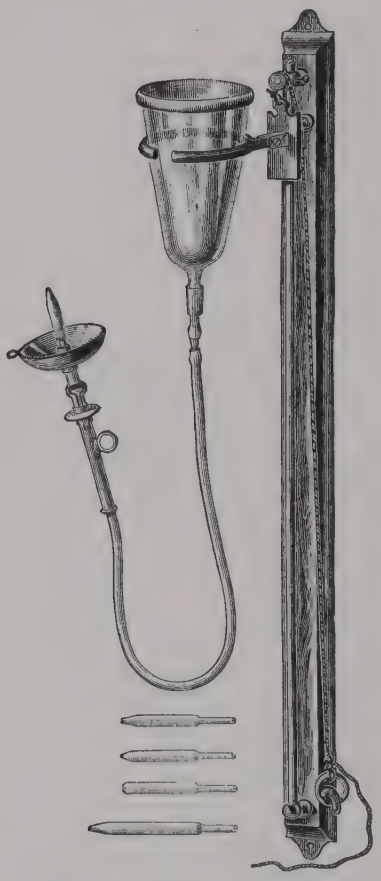


Fig. 172.—F. C. Valentine's irrigating outfit.

It is a common practice in making irrigations of the anterior urethra to increase the force with which the fluid is thrown into the urethra by elevating the reservoir, in order to overcome the resistance of the constrictor urethræ muscle and thus allow the fluid to enter the bladder The writers are opposed to this

method of bladder washing, for they believe that the danger of infecting the prostate or of increasing the virulence of any infection that may exist is thus enhanced. They recommend, when it is desired to wash the bladder, that this be done through a small, flexible tipped, bulb-pointed, French silk catheter, or through the small-sized, soft-rubber, velvet-eyed catheter, to the end of which a hand syringe or an irrigator may be attached, as the surgeon sees fit.

We are equally opposed to the routine method of forcing fluids into the bladder beyond the compressor urethræ muscle by one of the glass hand-syringes to which is attached a rubber tip for the purpose of thoroughly occluding the meatus. It is comparatively easy, by the use of one of these hand-syringes, such as the Janet, to force fluid back of the compressor urethræ muscle, and it is a procedure frequently carried out as a routine method by which irrigations are made along the course of the posterior urethra, especially in some of the dispensaries. When such procedure is carried out, if the irrigating apparatus is used, it should not have an elevation above five feet above the urethra. If the hand-syringe with a rubber tip is used, as much gentleness as possible should be employed in making enough pressure to force the fluid used into the bladder. From clinical observation of cases of urethritis, which have been treated by others, and have afterward come under our care, we believe the tendency of irrigations which overcome the contractile power of the compressor urethræ muscle by pressure is to cause more of an infiltration of the prostate than would otherwise exist. Under our observation such prostates, through a rectal examination, appear to be more swollen than in those cases of posterior urethritis in which irrigations have been made through a small olive-pointed catheter, as advised by us. Herasco, of Bucharest, in a recent communication to the Association Française Urology,[1] in discussing abscess of the prostate, states that he has operated forty times on abscess of the prostate, and that in most of his cases the abscess was caused by lavage of the vesical urethra without the use of the catheter. On the other hand, it is hardly necessary to state, when irrigating the deep urethra through a catheter, in

[1] "Ann. de Mal. Genito-urinaire," 1907.

addition to the necessary precautions as regards asepsis, great gentleness must be exercised; if any violence is used, it too will be liable to cause infection, and abscess of the prostate may ensue.

Treatment of Acute Posterior Urethritis

The pathologic changes that take place in acute posterior urethritis have been considered. As the result of the examination when the clinical symptoms show that the posterior urethra becomes acutely involved, all local treatment, if it has previously been administered, should cease. The patient should be put to bed, and proper hygienic measures instituted. The writers have previously expressed the belief that almost all cases of urethritis involve the posterior urethra; for this reason they advocate that all cases be treated from the beginning as if posterior urethritis were already established. In severe cases of posterior urethritis quinin in small doses is useful, and for the relief of urgent symptoms salol, sweet spirits of niter, infusions of uva ursi or triticum repens, or hyoscyamus and opium to relieve pain. The use of some of the infusions the formulas for which will be found in the article on the treatment of cystitis is recommended. Alkalis, if there are indications for their use, and hot sitz-baths make up, with the above, the treatment.

Treatment of Chronic Posterior Urethritis

This ordinarily is best treated by irrigations of silver nitrate, 1 to 10,000, or irrigations of the Ultzmann solution of phenol boric acid and zinc sulphate two or more times weekly, or by dilation with a Kollmann dilator for the deep urethra or by a combination of the above methods.

In cases of chronic posterior urethritis many practitioners believe in the efficacy of instillations, that is, the application of a few drops of such a solution as silver nitrate—2 to 10 grains to the ounce—by means of a soft catheter or through syringes, such as the Ultzmann, designed for the purpose. Instillations are not as efficacious as irrigations for inflammations of the posterior urethra that are at all diffuse in character; in those that are localized they may be of benefit. Instillations are useful, however, and the employment of them is sometimes attended with remarkably good results, so far as improvement in sensation of those who

suffer from neurasthenia accompanied by slight inflammatory lesions in the posterior urethra is concerned. Instillations are also of value as an adjunct to other measures employed in the treatment of lost or enfeebled sexual power as a result of this condition.

Ointments have been recommended by many writers for the treatment of chronic posterior urethritis, and exhaustive reference to them may be found in text-books on the subject. The writers' experience with them has been limited, the methods just mentioned having been found adequate and preferable. When threads alone are present, zinc sulphate ointment may be of use. A 10 per cent. aristol ointment is serviceable in hyperesthesia of

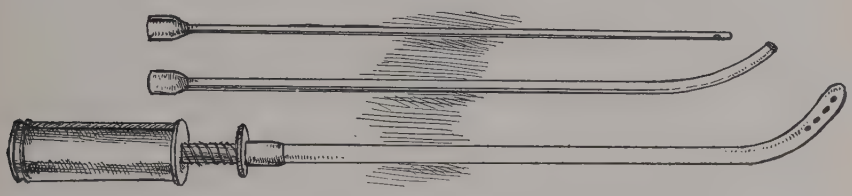


Fig. 173.—Hutchinson's catheter for applying ointments to the urethra.

the deep urethra. Other ointments useful in the treatment of chronic posterior urethritis are:

Argent. nitrat.	15 grains
Olive oil	1½ drams
Lanolin	3 ounces

or:

Potassium iodid	1½ drams
Iodin, pure	15 grains
Lanolin	3 ounces
Olive oil	1½ drams.

The application should be made by means of a steel sound devised for the purpose, having grooves on the outside to hold the ointment. Dr. Young, of Baltimore, has just invented an ingenious applicator. The Hutchinson syringe may be used if a Young's applicator or the grooved sound described is not available. This treatment may find more favor in future when it has been decided which is the best ointment base to use, and when the applicator best suited for the purpose has been made.

Various insufflators have been devised for the purpose of introducing powders into the urethral canal; however, they have been almost entirely discarded. Bismuth was the base of most of

the powders intended for this purpose, an antiseptic, such as phenol, often being added. Medicated bougies that melt at the body temperature have been widely vaunted as a remedy in this disease. In these cacao-butter generally forms the base, some antiseptic substance, such as phenol or iodoform, or an astringent, such as zinc sulphate, alum, or copper, generally being added. These do not, apparently, fulfil the indications so well as the other methods described.

In relapsing cases of chronic general urethritis hard infiltration is likely to be present, particularly when there is a history of previous infections. In these cases it may be found that quite a tight stricture exists in the urethra at the bulbomembranous junction. Dilation of the stricture at proper intervals rapidly cures the discharge; irrigations temporarily relieve it, but it is likely to return. The recurrent form of this disease occurs in patients who have had repeated attacks of gonorrhea extending over a series of several years.

Occasionally the discharge persists in the form of a drop or two, and does not respond to treatment. An examination of the anterior urethra by means of the endoscope will show that glandular infection has taken place and that glandular urethritis is present. In such cases the glands may be destroyed by electrolysis, instruments being devised for that purpose.

A condition that is quite frequently seen is that of peri-urethral urethritis, in which the glands are infected just inside the meatus. Such glands may be divided by a small knife or treated by electrolysis.

Résumé of the Treatment of Urethritis

The writers recommend the occasional adoption of abortive measures. They regard all cases of urethritis as involving the posterior as well as the anterior urethra, and treat them accordingly, *i. e.*, they advise that no intra-urethral local measures be adopted until after the acute symptoms have subsided and the discharge has become mucopurulent, such measures being then adopted as are indicated for posterior as well as anterior urethritis, and that the posterior as well as the anterior urethra be treated locally, when any local treatment is required, generally by irrigation of very weak solutions of silver nitrate or after some tenta-

tive irrigations of the Ultzmann solution have been used or by dilation.

Relapsing cases are generally due either to the too early institution of local treatment or to the presence of stricture. The treatment for this, together with the treatment of prostatitis, which in so large a proportion of cases accompanies chronic urethritis, will be dealt with in a later portion of this work.

COMPLICATIONS

The complications of gonorrheal urethritis are very numerous, but no attempt will be made to discuss any save the more important and frequent of these complicating conditions. In order to obtain a clearer view of the complications resulting from gonorrhea, it may be well to review briefly, in the light of our present knowledge of pathology, the relations that exist between the reaction of the tissues and the gonococcus when the body is invaded.

An acute gonorrhea follows the same course pursued by other infectious conditions in other portions of the body, modified somewhat by the shape and the function of the part attacked. As was previously shown, all the symptoms of an acute exudative inflammation appear. The exudation of pus, which is so terrifying to the patient, is not a disease in itself, but a symptom of the battle that is being fought between the infecting microorganism and the forces of the body—the effort of nature to conquer the infecting hosts. The fluid of pus is made up of serum from the blood, which in itself is a bactericide, and washes away with it organisms that have attacked the body, as well as the dead tissues resulting from the conflict that is going on. Swelling of the membranes is due to the surrounding protective walls of phagocytes or similar elements thrown out by nature to prevent the further invasion of the body, for nature always makes an effort to protect the whole as much as possible. The body having thus been protected at the expense of the urethra, after the acute exudative inflammation has passed off, excoriations, granulations, and beginning formation of cicatricial tissue occur. The system has to a considerable extent been saved, but at the expense of the part; hence as the result, generally, of constitutional conditions or of unwise treatment complications of urethritis often occur. Among these are phimosis, paraphimosis, balanitis, lymph-

angitis, invasion of the parietal glands with resulting parietal abscesses, and invasion of the follicular glands of the urethra with resulting follicular abscesses. The prostate and the seminal vesicles often become involved, cystitis may ensue, and invasion of the kidney and pyelonephritis may result. The nervous system is occasionally attacked, and myelitis and meningitis of gonorrheal origin may occur. Involvement of the testicles manifests itself by the onset of epididymitis and orchitis, which may lead to stenosis of the vas deferens, producing sterility. Osteomyelitis, phlebitis, pulmonary infarct, pleuritis, and endocarditis may occur.

Gonorrhea of the mouth and of the rectum is extremely rare, but cases are occasionally reported, and, according to Caspar, gonorrheal stomatitis of the newborn is found now and then. Caspar quotes Jaddeson as saying that gonorrhea of the rectum has been known to result from rupture of a prostatic abscess, as well as from direct inoculation.

Gonorrhea of the eye and gonorrheal rheumatism are such frequent complications that they merit detailed description here. For the following article on "Gonorrhea of the Eye" we are indebted to Dr. Richard Kalish, of New York.

Gonorrhea of the Eye.—Specific urethritis may cause both extra-ocular and intra-ocular disease, the most frequent manifestation of the former being acute blennorrhea of adults, and of the latter, iritis.

Acute blennorrhea, called also purulent or gonorrheal conjunctivitis or ophthalmia, is due to contamination from urethral discharges, usually carried by the fingers of the patient; one eye is first affected, and it is generally possible to tell from this whether the sufferer is right or left handed. Other means of infection are the hands of nurses and soiled dressings. In four cases seen in the writer's practice the source of infection was traced to the towels used in the offices where patients were employed. From an extensive clinical experience, the writers cannot concur in the opinion that the toxins of the gonococcus circulating in the system may produce gonorrheal conjunctivitis.

Symptoms.—In every case of this disease the gonococcus of Neisser is present. The symptoms appear very soon after inoculation,—usually within forty-eight hours,—and at first, on casual

inspection, resemble those of acute catarrhal conjunctivitis; a closer examination, however, discloses the fact that the ocular conjunctiva presents a more brawny and turgid aspect. Great swelling rapidly supervenes, with intense congestion of the conjunctiva, and a marked chemosis forms an elevated ring surrounding the cornea which appears as if sunken to the bottom of a pit. The slight opalescent excretion quickly gives way to a very profuse, greenish yellow discharge, presenting the physical characters of that of gonorrhea. Unless modified by active and unremitting treatment, all these symptoms rapidly become aggravated. Ulcers appear on the cornea and may perforate it, or, as has occurred in the writer's hospital service, the entire cornea may slough, extrusion of the ocular contents and collapse of the globe following. In other cases, after a small perforation has taken place, prolapse of the iris occurs, which is succeeded by infection of all the deeper structures, setting up a general inflammation or panophthalmitis.

Prognosis.—With the modern treatment of this disease recovery may usually be expected and the dangerous sequelæ of the past—leucomata, partial or complete staphyloma, incarceration or synechia of the iris, and panophthalmitis—do not often follow, provided the patient is seen early in the attack and before there has been any interference with the nutrition of the cornea.

Treatment.—One eye being usually first affected, the other should be protected from infection by covering it with a Buller's shield; this is made of a watch-crystal of large size (the writer uses a lens from the so-called driving glasses), fitted in an oval piece of rubber adhesive plaster. This is carefully applied to brow, nose, and cheek, but not to the temple, for if hermetically sealed, the insensible perspiration within the shield, condensing on the inside of the lens, would smear it and thus prevent the early recognition of infection of this eye, if this unfortunately occurs. The rubber plaster easily becomes loosened; the edge and the contiguous skin should, therefore, be painted with flexible collodion into which a few shreds of absorbent cotton should be incorporated before the collodion hardens; the union of protector and skin will then be complete.

Unremitting care is the key to the successful treatment of this disease. Ice-cold compresses must be applied continuously as long as the cornea remains unclouded. They are best used in the

form of two-inch squares of patent lint which should be placed on a block of ice. These compresses must be changed often enough to keep the lids chilled—about from every fifteen to thirty seconds at first; later at longer intervals. Before applying them to the eyelids the integument should be anointed with an ointment consisting of equal parts of cosmolin and simple cerate. Vaselin is too quickly washed away to prevent the dermatitis caused by the cold application. Every three hours a small lump of white vaselin should be placed under the lids by means of a probe.

The discharge must be removed as rapidly as it forms, for the integrity of the globe is threatened not only by the swelling of the lids and ocular conjunctiva, causing nutritional interference, but also by the acridity of the secretion. Success is impossible unless absolute cleanliness is maintained; therefore the advice to clean the eyes every twenty minutes cannot be too severely censured. The discharge must be wiped away as soon as it forms—at first every time a cold pad is applied. Irrigations of a warm saturated solution of boric acid should be employed at least every fifteen minutes. Solutions of mercuric bichlorid, biniodid, or cyanid cannot be used in germicidal strength and are, even in these weak solutions, too irritating. The irrigator should not be placed at a height of more than 18 inches above the head of the patient, and the solution should flow over, and not strike, the eyeball. As soon as the cornea assumes a steamy appearance the use of the cold pad must be discontinued and heat, as strong as the eye can bear, must be substituted. If hot compresses are employed, the water should be heated at the bedside. The best method of applying heat is to fill a glass to the brim with hot water and let the patient hold this to the eyelids, opening and closing the eye under the water. Irrigation should be practised as often as the discharge accumulates, even if required at five-minute intervals. Alum should never be applied, as it dissolves the cement holding the corneal plates, and thus favors the entrance of micro-organisms, to the subsequent danger of the eyeball. For similar reasons cocain should not be used, except early in the attack. To arrest the discharge and to destroy the gonococcus protargol or argyrol should be thoroughly applied to the conjunctiva in from 10 to 25 per cent. solutions. These applications should be made from every three to six hours, depending upon

the quantity of the discharge and the rapidity of its production. These remedies are much superior to the argentic nitrate, since they may be used from the very inception of the trouble, whereas the nitrate must never be used until the stage of secretion is fully established; the latter, furthermore, does not penetrate the infected tissues as do both protargol and argyrol.

The writer does not favor scarification to relieve the turgid conjunctiva, as it is likely to permit infection of the deeper seated structures. Marked benefit may be obtained by the application of three or four leeches to the temple, the bleeding being favored by hot fomentations. Leeching may advantageously be repeated in selected cases every third or fourth day.

Whenever swelling of the lids produces injurious pressure on the globe, a canthotomy should be performed. Corneal ulceration when centrally located calls for atropin; if situated peripherally for eserin or pilocarpin. Abscission should never be performed for prolapse of the iris, for this opens up a channel for infection of the deep structure of the eye, and subsequently panophthalmitis will occur. The eyelids sometimes recover completely, but in other cases there follows a true trachomatous process, which demonstrates that trachoma is a hypertrophy of the subconjunctival adenoid tissue, resulting from inflammation, etc., instead of being caused by a special micro-organism. For this sequel scarification, followed by the application of tannic acid in glycerin (2 to 10 per cent. solution), will usually effect complete recovery.

Ophthalmia Neonatorum.—Ophthalmia of the new-born is due to infection contracted during the passage of the child's head through the mother's vagina. Other modes of infection are those mentioned as occasionally operative in the causation of gonorrheal conjunctivitis in adults. There are two types of this disease—a mild one, which yields readily to the ordinary treatment for acute catarrhal conjunctivitis, and a virulent one, in which the gonococcus is always present. As a rule, with proper precautions, this is a preventable disease; and as reliable statistics have shown that from 30 to 55 per cent. of all cases of blindness are due to this condition, neglect to observe such precautions is criminal. In all suspected cases the Credé preventive method should be adopted, *i. e.*, as soon as the child is born or, better, as soon as the head emerges from the vulva, the face should be cleaned, the

eyelids separated, and one drop of a 2 per cent. solution of silver nitrate should be instilled in each eye. In extremely rare instances conjunctivitis follows this treatment, demanding the use of cold compresses, cocain, and irrigations with warm boric acid solution; as a rule, however, there is no reaction to the silver application. When ophthalmia neonatorum does occur, the treatment should be as active and energetic as that recommended for purulent ophthalmia in the adult.

Iritis.—This is the most frequently observed form of intra-ocular disease due to systemic involvement. Not infrequently the attack cannot be differentiated from rheumatic iritis. Usually a knee-joint is first affected, then the eye, and in some cases these alternate. The iritis is often bilateral, attacking the eyes simultaneously or in succession. The symptoms and course are identical with those of rheumatic iritis, and as these attacks occur so often in patients who are the subjects of rheumatism at other times, the gonorrheic implication is, to say the least, a doubtful one.

There is, however, one form of iritis that seems to depend on metabolism of the gonococcus. It occurs early in the course of the gonorrhea, none of the avascular structures of the joint being affected. It usually attacks but one eye, although both may be affected, and severe inflammation is the rule. The pupil is often occluded by a grayish lymph, and there may be an abundant exudation in the anterior chamber. If seen early in the attack, a cure is confidently to be expected. A striking case of this kind was seen in the summer of 1905. The patient's first attack of gonorrhea was accompanied by a severe iritis. A similar condition occurred with his second attack, and also with the third—for which the writer was consulted. Only one eye—the right one—was affected. He had never had rheumatic attacks, and had suffered but these three attacks of gonorrhea, in each of which iritis supervened within ten days after the urethral discharge had been established.

Among other intra-ocular diseases attributed to the toxins generated by the gonococcus are cyclitis, iridocyclitis, and chorioretinitis. In the course of a gonorrheal attack of long standing amblyopia has been observed to occur. In these cases the distinctive symptoms are a sluggish and slightly dilated pupil, with hazy vision, scintillating scotomata, and an inability to read or

write for more than a few minutes at a time. In a case seen in the writer's private practice there was likewise a restriction of the field of vision for both eyes, at the nasal side. When the gonorrhea was cured, complete visual restoration followed.

Gonorrheal Rheumatism.—This term is most unfortunately chosen, and is unquestionably responsible in part for the misunderstanding so prevalent in regard to the disease. It is to be classed in no way with any variety of rheumatism except in point of differential diagnosis. It is due to a specific and well-accepted etiologic factor, affecting the synovial sacs, the tendinous sheaths, and in rare cases the investment of the nerve-trunks as a simple inflammatory process. It is an infectious synovitis, and is due in all instances to infection with the gonococcus, though in some instances the infection may be mixed. In a sufficient number of cases the gonococcus has been recovered from joints involved, though on account of the elusive nature of this organism to ordinary methods of bacterial investigation, it may not be always possible to demonstrate it. There is some evidence to indicate that the organism itself may not invariably be present in the involved areas, but that the symptoms are due to the production of some toxic body, specific in nature, which is elaborated by or in the presence of gonococci. This toxic theory is largely substantiated by the fact that very frequently, when the original nidus of infection be healed, the disease disappears spontaneously without local treatment of the inflamed tissues of the joint or general measures.

In the opinion of the writers, however, subjects especially susceptible to rheumatic diseases are rather more liable to develop gonorrheal synovitis rather than those not so inclined. We explain this fact by the theory of lowered tissue resistance. The disease is not a very frequent one, fortunately, but occurs in the experience of every general practitioner, internist, surgeon, and urologist with quite sufficient frequency. Various writers estimate the proportion of occurrence at from 2 to 10 per cent. of the total number of cases of gonorrhea. It undoubtedly occurs more commonly in male than in female patients. This is probably largely explained by the fact that in the male gonorrhea is more apt to be a persistent disease in which hidden foci of possible infection exist for a longer period than is common in women, except in instances of uterine or tubal infection.

Course.—Gonorrheal synovitis rarely appears during the acute stages of an active infection, but is most common in the later stages, and is seen rarely in cases which are free from complicating lesions, such as a serious posterior urethritis, epididymitis, or gonorrheal vesiculitis. It may arise, however, during the early acute stages, particularly in secondary or recurrent cases, or it may occur months after the original infection has subsided. In practically all the instances which have fallen under the observation of the writers some focus of persistent infection could be demonstrated after sufficient search. The most frequent seats for such foci in our experience have been the posterior urethra, and especially prostatic abscess and vesiculitis. In many cases the local symptoms are so slight as to fail to attract the attention of either the patient or the careless clinician. The frequency with which the disease arises after forceful instrumentation in cases of gleet or posterior urethritis should be held as very significant.

The onset of the disease is rarely acute and active, but is more apt to be relatively slow and to be preceded by several hours, days, or weeks of mild pains in the region of the infected joint. With the onset there is commonly a moderate rise in temperature, with proportionate quickening of the pulse, pains in the back, and the general symptoms of infection. Occasionally the disease is violently inaugurated, with rigor, high temperature, and profuse sweating. Ordinarily, but a single joint is at first involved, though subsequently others may become invaded. The joint most frequently attacked is the knee, the tendons of the foot, such as the tendon at the plantar aponeurosis or the calcaneus, often being likewise affected. It may attack other portions of the feet, may give rise to periosteitis of the calcaneus, and may cause myositis and various forms of synovitis. Next to the knee and the foot, it shows a predilection for the elbow. Occasionally the attack terminates in suppuration, which possibly breaks through the joint, with the usual accompaniments of abscess formation, such as fever and chills. It is stated, and we believe correctly, that with the onset of the synovitis an increase or reappearance of the urethral discharge is likely to develop.

The involved joint swells, oftentimes to a considerable degree, but it rarely takes on the deep-red color seen in the average case

of acute articular rheumatism. Movement of the articulation is productive of exquisite pain, but when the joint is immobolized and kept at absolute rest, the pain is generally not so great as in articular rheumatism. The disease may be accompanied by severe sweating, but this is never so pronounced as in true rheumatism, nor is the sweat of so striking and acrid an odor. Prostration is generally not marked, except in those cases complicated by bacteriemia and endocarditis. Endocarditis is occasionally seen as an accompanying lesion, but it never occurs with the frequency with which it is seen in rheumatism.

Diagnosis.—The disease must be differentiated from acute articular rheumatism, from simple synovitis, rheumatic gout, and acute cases of tubercular arthritis, and from occasional instances of acute syphilitic synovitis. One of the most important steps in the diagnosis is the history of a relatively recent attack of gonorrhea, and in a large percentage of cases the detection of foci in which gonococci may still be demonstrated. The less prostration and sweat, the less tendency to migrate from joint to joint, and the less frequent occurrence of endocarditis are important points in the differentiation from acute articular rheumatism. Where endocarditis is present, blood cultures may show the presence of the gonococcus, on the one hand, or of the streptococcus or staphylococci, on the other. Similarly, in cases of simple arthritis, in cases of septic nature, the demonstration of the nature of the hemic infection is a point of very conclusive value. Leukocytosis, which is absent in the gonorrheal condition, is also a helpful diagnostic sign in general septic states.

The differentiation from rheumatic gout is, in our opinion, most difficult in many instances, and in some cases must rest on the results of treatment if gonococci cannot be found in any of the usual tracts. From acute tubercular arthritis, the less active nature of the infection, the detection of tubercular foci elsewhere, or the presence of a Calmette or vaccination tubercular reaction are points of importance. Within a few days' time the differentiation from acute syphilitic synovitis is a matter of ease, owing to the appearance of other manifestations of this general infection.

Prognosis.—The prognosis as regards life is good. Gonorrheal rheumatism shows a tendency to go on to recovery, in the majority of cases, in from three to four weeks, without receiving any treat-

ment whatever; some cases have, however, been known to persist for months in previously healthy individuals.

Owing, probably, to continued absorption of the virus of gonorrhea from the urethral wall, in a small proportion of cases a very obstinate form of arthritis is set up—knee- or elbow-joints, synovial tendon-sheaths of wrist or foot, etc., may be affected by an inflammatory process secondary to the gonorrhea. This generally takes the form of a hydrops of synovia, which is very slow to clear up and appears about three or four weeks after the infection has taken place. Very rarely suppuration occurs in all the involved joints, with the attendant dangers of pyemia. The disease may in such cases terminate in more or less stiffened joints, and ankylosis is not unknown.

Treatment.—This primarily consists in the treatment of any inflammatory conditions of the urethral canal that may exist. Most commonly a posterior urethritis is present in conjunction with the rheumatic symptoms, and this must receive the proper treatment, such as occasional deep irrigations with weak solutions of silver nitrate. The results of the employment of very heroic measures in the treatment of inflammatory conditions of the urethral canal, such as opening the seminal vesicles for the cure of gonorrheal rheumatism, are difficult to estimate properly. If skilfully carried out, these measures may produce excellent results, and in some of our cases great benefit has followed. The method is not one, however, for general use, and probably has a very limited field of application. The fact, however, that gonorrheal synovitis shows a tendency to recover is one of the reasons why it is so difficult to estimate the amount of benefit actually derived from the use of any therapeutic measure, medical or surgical. The affected joints should be immobilized. Applications, either of heat or cold, as the patient may find most soothing, should be made. Cloths wrung out of hot lead-and-opium solution and reapplied as frequently as they become cool will be found useful when the pain is severe. In a few cases we have found the application of ice-bags or cloths soaked with ice water to give great relief. Vasogen iodin may be well rubbed into the affected joints two or three times a day; this has been especially efficient in chronic and persistent cases. This same local treatment will also be found beneficial in other conditions,

such as involvement of the synovial sheaths. An ointment composed of ichthyol and oil of wintergreen has acted well in some cases. Various other stimulating applications, such as chloroform liniment or one of the menthol preparations, may be employed.

Internally, the treatment should be that of septicemia; tonics of iron, quinin, and manganese, sulphur compounds, and preparations of phosphorus may all be employed advantageously. It is the custom to recommend salol, aspirin, and various other forms of the coal-tar products, which have a decided analgesic action and also serve as urinary antiseptics. We have found aspirin the most efficient of this class. Urotropin sometimes acts well, probably for the same reason. In some cases the use of powerful hypnotics, as codein, veronal, and morphin, may become imperative. It has been our custom, for many years past, to employ oil of wintergreen, five to twenty drops, three times a day. In a good many cases this relieves the pain, but we do not feel that it materially shortens the course of the disease.

In some chronic cases the alternating hot and cold spray acts well, and in persistent cases we have used the Bier hyperemic treatment with signal success; in one instance, however, we must note that the disease appeared to become much worse after this method. The use of dry heat and the *x*-ray both have their advocates, but our experience does not lead us to favor either. Massage and passive movements are also to be used only with great care, and alone in quiescent cases. The general tone of the body should be improved, and for this purpose glycerophosphates and various other constructive tonics in large doses will be found beneficial.

In our experience we have not found it necessary to restrict the diet, as in rheumatism, and for most largely afebrile cases we recommend a full and nourishing though readily digestible diet.

The serum and gonococcus vaccine treatment of gonorrheal rheumatism, both acute and chronic, and for such conditions as epididymitis has justly of late received consideration by many observers. From our own investigations, in which we have been aided by H. M. Beardall, House-Surgeon of the New York City Hospital, we feel that we can speak more positively as to their merits than in the preceding editions of this work. The *serum* is a product of cultures of gonococci injected into horses. After

a time the horses are bled, and the blood serum (antigonococcic serum) used to combat infections of the gonococcus.

The gonococcus vaccine is a suspension of dead gonococci of various strains in saline solution. We have found the serum useful in the treatment of acute gonorrheal rheumatism, and in a lesser degree in the treatment of chronic gonorrheal joint conditions. It should be injected to the amount of 2 c.c. at a time, the injections repeated at intervals of two or three days, and several injections used unless amelioration of the symptoms have taken place. It is advised by the manufacturers to follow up the serum with injections of the vaccine. So far we have not been as successful with the vaccines as with the serum. We think we have found the vaccine of some benefit in the treatment of epididymitis. We have used the vaccine, commencing with doses of 10,000,000 bacteria per cubic centimeter and working up, injecting the vaccine at intervals of three to five days. We have used the serum and vaccine as put up by Parke, Davis & Co., following the suggestions of Dr. Seaborn, the Director of their Scientific Department. We have not had any unpleasant after-effects follow the use of either the serum or the vaccine. For urethritis, acute and chronic, the above preparations are of no value.

When complications, such as ankylosis, persist after recovery from the acute condition has taken place, these should be treated according to the rules laid down in the text-books on orthopedic surgery.

Gonorrheal Endocarditis.—Gonorrheal involvement of the endocardium is probably a much more frequent disease than is generally recognized. Since it may occur in mild form with no more septic reaction, in the way of fever, chills, or prostration, than might be accounted for by the urethral condition, it is highly probable that cases have slipped the notice of all of us. The lesion is, of course, most apt to arise in the course of gonorrheal bacteremia or synovitis, but may be seen in apparently simple cases.

As a rule, the symptoms are quite pronounced, and are manifested by night temperature, with morning fall, chill at onset, and a typical septic course. As with ordinary acute endocarditis, the temperature-curve may strongly suggest malarial infection. As just mentioned, clinical manifestations may, however, be slight and pass unrecognized until the heart examination shows the presence of an acute murmur. As a rule, the mitral segments

are mostly involved, and next to these the aortic flaps. These are the only two valves which we personally have found so diseased.

Diagnosis must rest on the detection of the murmur, with the usual symptoms of endocarditis, associated with gonorrheal infection, but absolute diagnosis is only possible when the gonococcus can be isolated from blood-cultures. By no means all cases of endocardial infection arising in the course of gonorrhea are of this specific nature, for other organisms may enter through the disease focus. A case of gonorrheal synovitis recently seen in the service of one of the writers showed the development of an acute endocarditis, with classic signs and symptoms. The case was naturally supposed to be one of gonorrheal endocarditis, but blood-cultures showed the gonococcus absent and a streptococcus present.

In the few cases which have fallen under our clinical observation the general course of the disease has been less violent than in ordinary endocarditis. No detectable infarctions have appeared, and all save one of our cases recovered. Other observers record quite contrary findings, and it seems probable that our fortunate results were entirely a matter of chance.

The treatment consists of the usual measures employed in acute ulcerative endocarditis, plus active treatment of the local gonorrhea. Rest in bed and the ice-bag to the precordium are the most important of the measures specifically directed to the cardiac disease.

Stricture of the Meatus

In the male this is quite common; less so in the female. Generally it is hereditary, although it may be the result of disease. The meatus occasionally being only pin-hole in size, admitting only a small instrument, conditions similar to the above may cause no trouble, except that if infection of the urethra has once taken place, the size of the meatus may interfere with drainage and may retard recovery, which would be materially hastened by incision of the opening. It is frequently necessary to enlarge the meatus by incision to obtain room for the introduction of such an instrument as a cystoscope. Meatotomy is performed as follows: Soak a pledget of cotton wrapped around the end of an applicator or probe in a 4 per cent. solution of cocain; insert it into the urethra for an inch; apply over the frenum another

pledget of cotton soaked in cocain and have the patient make pressure over the two for ten minutes; then remove the cotton from the frenum and the cotton plug from the urethra and with a straight blunt-pointed knife or a meatotome (fig. 174) incise the meatus and about half an inch down the urethra until a No. 30 French sound can be easily passed. It is well to remember that after healing the size of the meatus will be two or three numbers smaller than what it was originally cut to. To stop the bleeding after the incision the same urethral plug can be introduced that was used before the incision and counter-pressure made on it over the frenum. The patient should be

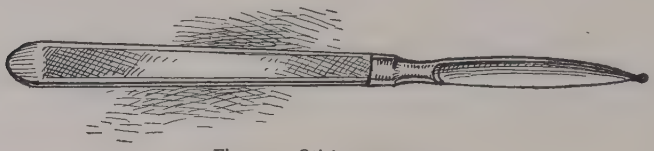


Fig. 174.—Otis' meatotome.

loaned a short straight sound made for the one purpose, with instructions to introduce it three times daily for three or four days to keep the cut open, or otherwise it may grow together again. The incision, it is hardly necessary to remark, should be made on the floor of the urethra toward the frenum. Instead of using the cotton plug with cocain a few drops of the latter can be injected into the frenum.

Stricture of the Urethra

Symptoms.—A stricture of quite small caliber may sometimes be present without exhibiting any manifestations of its existence. Such patients may complain of pain on urination and frequency, particularly during the day. Prostatic cases, on the other hand, are likely to be troubled by frequency of micturition occurring at night or toward morning. A slight discharge from the meatus often accompanies stricture, and it is often the cause of a relapsing urethritis. It is frequently associated with some disturbance of the sexual function. In stricture the caliber of the stream is influenced to a greater or less degree by the extent of the stricture. Thus it may be but little diminished or may be forked; there may be dribbling after urination, and in a stricture of very small caliber

the patient will pass a thread-like stream, not infrequently tinged with blood; in strictures that cause almost complete occlusion only a few drops at a time can be passed, the effort being attended with much pain and difficulty. The form of the stricture can be perfectly shown only by practising intra-urethral instrumentation.

Location.—The majority of strictures occur in the membranous urethra, and practically all that need operative interference are found there; those occurring in the anterior urethra, with but few exceptions, are capable of being dilated.

Treatment.—The treatment of stricture, like the treatment of hypertrophy of the prostate, will, in the future, be largely of the preventive form. In the section on the pathology of this condition it was shown that true stricture is the formation of scar tissue at the base of a granulomatous lesion. It may be assumed that if urethritis were so treated that no granulation tissue formed, true stricture, which is made up of resulting scar tissue, would not occur. Unfortunately, through either unwise treatment or neglect, scar tissue does follow urethritis in a very large proportion of cases. Quite often, however, these scars are so small that they never give rise to any apparent symptoms.

For diagnostic purposes, when the stricture is not a very tight one, an ordinary olive-pointed bougie having a circumference of No. 16 or 18 French, will prove a useful instrument. If the bougie passes into the bladder easily, and then shows a tendency to pop out, because of the good contractile power of the compressor urethræ muscle, the probabilities are that no stricture of particular consequence exists, either in the anterior or in the posterior urethra. Often small masses will be encountered in the anterior urethra as the olive point slides down the surface. These are very likely to be granulomata, particularly if chronic urethritis is present; they are commonly known as soft strictures, and have been mentioned and illustrated elsewhere. If a more definite examination of the anterior urethra is to be made, a rubber bougie à boule may be used. The largest one possible should be made to slip by the obstruction; when the next one larger fails to pass, the caliber of the stricture may be estimated. A very useful instrument for the purpose of measuring the diameter of the anterior urethra is the urethrometer of the late Dr. Fessenden D. Otis, previously illustrated. If it is desired, the

anterior urethra may be inspected with the endoscope in order to observe whether granuloma or true stricture is present. The granulomatous infiltrations are benefited by any measure that stimulates circulation through the parts without unduly irritating them, such as pressure by means of bougies or steel sounds or by the use of the straight Kollmann dilator; if the infiltrations are situated at the bulbomembranous junction, the curved Kollmann dilator should be used. These cases of stricture should, when possible, be kept under observation for some time, and dilation should be performed about once a week. The granulomatous infiltrations will also disappear under stimulating irrigations, such as silver nitrate, without pressure being used. The foregoing remarks have reference only to the treatment of strictures of a caliber that will admit a No. 12 sound or one of large diameter. These strictures are rarely seen without some accompanying chronic inflammatory condition of the urethra, and are best treated not only by distention, but by irrigations as well. As a rule, several processes are going on at one time in the same urethra. Divulsion should never be performed; this method of tearing a stricture apart by means of special instruments devised for the purpose has been productive of much harm. The old-fashioned instruments used for this purpose served as a model from which the Kollmann dilator was evolved, an instrument that, when properly used, will be found of great value. Kollmann dilators are procurable in three forms: The straight, which are used for the anterior urethra; the curved, with the prostatic curve, for the deep urethra, and covered with rubber; and curved for the deep urethra, which are intended for irrigation at the same time, and that are not covered with rubber. The writers prefer the curved that are covered with rubber. Irrigations can be performed through a small silk catheter immediately after passing the Kollmann dilator or at a subsequent visit. In individuals with sensitive urethras it is better to postpone irrigation after dilation to a subsequent visit. Undoubtedly in the past many of the masses of granulations mentioned have been incised under the classification of "urethrotomy for strictures of large caliber," an operation which has to a great extent passed out of use. While in very exceptional cases it may have been productive of good results, it often caused harm, generally by causing after-deformi-

ties of the penis. Dilation is as useful for true stricture as it is for the granulomatous masses; only true scar formation yields less readily to treatment. When the true strictures are not too tight, the same general rules should apply as in the dilation of the softer variety.

A stricture that has been so widely dilated that it will admit a Kollmann dilator, of the caliber of No. 20 French, may be stretched until a sense of resistance is felt and the patient complains of pain,

Fig. 175. — Kollmann's straight dilator.

Fig. 176. —Kollmann's dilator for posterior urethra, with irrigating attachment.

Fig 177. —Kollmann's double curved dilator for posterior urethra.

Fig. 178. — Kollmann's curved articulated dilator with Beniques curve for posterior urethra.

or until the index has been screwed up ordinarily two or three points from the caliber which it had reached on a previous visit. Under any one of these conditions distention should not be carried further. The dilator should not be allowed to remain in the urethra for more than ten minutes. Strictures of the anterior urethra proper rarely produce harm in themselves, and they can, as a rule, be very rapidly dilated. After the urethra has been dilated to No. 40 or 42 French by the Kollmann dilator, or so widely that it will admit a No. 32 or 33 French sound with comparative ease, the stricture may be considered cured so far as distention is concerned. The chronic urethritis accompanying the condition may, however, require further treatment in the form of irrigations. In any case the patient should be advised to report three or four times a year in order that any tendency to further stricture formation may be detected.

In using the Kollmann dilator for the deep urethra when it is desired to dilate the bulbous more than the posterior urethra, the handle of the instrument should be somewhat elevated. To dilate the bulb while stricture exists, the instrument, still expanded to the extent that will not cause too much inconvenience to the patient, should be slowly withdrawn from the urethra. True cicatricial strictures are probably not much benefited until dilated beyond 30. Once the Kollmann instrument has been introduced by the surgeon, the patient may, if desirable, perform the dilation himself. The procedure may consume ten minutes, the instrument remaining in place a few minutes at full dilation. Irrigations may be used after or between the dilations. The treatment should extend over a period of at least three months, dilation being performed at intervals of a week in the case of old persons; young and middle-aged patients with true stricture may allow longer intervals to elapse between dilations without giving any evidence of recontraction. After a certain stage of the treatment has been reached, especially with the latter class of patients, the urethra will generally remain well dilated for months or a year without requiring further instrumentation. It is a good plan, in dilating for stricture, occasionally to observe, by means of the endoscope, the effects of the instrumentation on the urethra. A change from a whitish or grayish to a pinkish color is a good indication.

For performing thorough dilation a silk bougie, the steel

sound, or the Kollmann dilator may be used. For dilation up to No. 20 F. the best instrument to use is the silk bougie; beyond that the steel sound or the Kollmann dilator should be employed. During the last few years the writers have used the Kollmann dilator more and more in private practice, and have almost entirely discarded the steel sound. In using steel sounds above No. 20 F. care should be observed to choose conically pointed sounds rather than the blunt ones so often placed on the market. It is not advisable, ordinarily, to pass more than two or three sounds at one sitting. Such sounds may gradually increase one to three numbers in diameter.

Treatment for Retention of Urine and of Tight, Impassable Stricture

In examining a patient who is unable to urinate or who voids a very small stream with much difficulty, it should be remembered, before making any examination, that if the patient is old and gives a history of gradually increasing urinary difficulties, the retention is very probably due to enlargement of the prostate. If the man is of middle age or younger, particularly if he has been very careless or dissipated, the probabilities of the urinary difficulties being due to stricture are much stronger. When retention occurs as a complication of acute urethritis, it is due to intense swelling of the walls of the urethra, and true stricture is often absent.

Hot sitz-baths and efforts to urinate under hot water in a bath-tub, the water covering almost the entire body, will generally facilitate the flow of urine. Such measures should be given a fair trial in the effort to overcome a recent attack of retention before instruments are made use of.

Whatever be the conditions suspected, it is well, in making an examination, first to attempt to pass an ordinary olive-pointed, very flexible tipped, French silk catheter of a caliber of about No. 16 or 18. If it meets with an obstruction, as it very often will, at the bulbomembranous junction, three points are to be considered—whether we are dealing with stricture, with an enlarged prostate, or with spasmodic stricture due to nervousness. Spasmodic strictures are generally quite easily recognized by any one who has considerable clinical experience in the treatment of urethral disorders, but the inexperienced practitioner will some-

times find them quite confusing. If it is suspected that the inability to enter the bladder and the obstruction at the bulbomembranous junction of the urethra are due to a spasm of the compressor urethræ muscle, a steel sound, a few sizes larger than the catheter previously mentioned, may be inserted, remembering that by making slight gentle pressure at the bulbomembranous junction spasm may almost always be overcome. This failing, an attempt should be made to overcome the spasm by injecting a considerable quantity of warm water through a soft catheter carried as far as the seat of the occlusion. If this irrigation through the catheter is continued for some time,—ten or fifteen minutes,—it will generally be possible, then, after the catheter

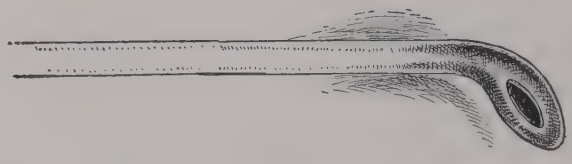


Fig. 179.—Mercier's elbowed metal catheter.

has been removed, to pass an instrument into the bladder if the constriction was really due to spasm. If an obstruction is present that hinders the passage of a small olive-pointed bougie and not due to spasmodic occlusion, this is due to one of two conditions—stricture or retention caused by an inflamed hypertrophied prostate. If due to hypertrophy of the prostate, this is generally made clear by the history of the case, the age of the patient, and the marked rectal enlargement of the prostate that is to be felt. In such cases, which are comparatively rare, but which do occasionally occur, the urethra takes a different curve from the normal, and it is for this reason that the ordinary catheter will often not enter the bladder, necessitating the use of a catheter of a particular curve. The Mercier curve, which is to be had in steel or rubber catheters, will generally prove effective. This failing, a steel catheter with a large prostatic curve may be used; if this too proves unsuccessful, a bicoudé curved catheter may be used. It is the writers' custom to keep on hand a series of these three catheters. They are extremely useful at times if the retention is due to enlarged prostate. After the catheter has entered the bladder, that organ may be emptied and washed out. The advisability of an imme-

diate operation should now be considered, or another catheter may be passed in a few hours' time. These cases have been more fully dealt with in the chapter on Diseases of the Prostate.

If the retention is not due to prostatic obstruction, stricture exists. An effort should first be made to pass the stricture with some instrument and later to dilate it. For passing the stricture the following procedure may be adopted: The urethra is filled with warm oil and bougies of gradually decreasing caliber are inserted until the filiform bougies are reached. By the exercise of much care and patience on the part of the surgeon the vast majority of cases of stricture of small caliber may be passed by a filiform bougie. When one bougie has been passed, an attempt may be made to introduce another one alongside of it. If the ordinary whalebone bougies fail to pass, catgut bougies, which are still finer, may be tried. Some urethras are so long that a bougie of double the ordinary length may be required to reach the bladder. After the filiform has entered the bladder, in cases where the retention is not complete and the patient able to urinate a little, it may, if desired, be tied there for a few hours, at the end of which time a very small bougie—one larger than the filiform, however—can usually be substituted. Not infrequently the attempt is made to enter the bladder by inserting a tunneled steel sound of the smallest caliber over the filiform.

Fig. 180.—Gouley's tunneled sound and guide.

If this steel sound can be passed into the bladder over the filiform acting as a guide, the problem, so far as retention is concerned, is generally solved. The stricture may be so much distended by the passing of larger and larger tunneled sounds over the filiform that after a short time a catheter may be forced in and the bladder emptied.

The after-treatment will consist of rest in bed, the use of urinary antiseptics internally, and gradual distention by means of

steel sounds, larger and larger ones being passed at intervals of every four or five days. If it is found impossible, by any of the means described, to get the best of the stricture, the situation becomes somewhat more perplexing; in similar cases the writers have found the use of a certain instrument to be of great value. This is a modification of the long, whip-like filiform known as the Banks bougie. This bougie is extremely small at one end,—the size of the smallest filiform,—and gradually grows larger so that toward the upper end it has a diameter of a No. 10 French.

Fig. 181.—Points of Gouley's whalebone guides.

The objection to Banks' bougie is that, being made of whalebone, is it somewhat rigid; to overcome this, one of the writers had a bougie of similar shape made of vulcanized rubber. This is much more flexible than the original form, and has repeatedly proved successful where other instruments have failed; for, if the end will pass the stricture, it is only necessary to continue pushing. The lower portions of the shaft will double up as it enters the bladder, without doing any harm, so it may be pushed on until the full diameter of the shaft is engaged in the stricture. After withdrawal, it is comparatively easy to pass a small ordinary silk bougie and so continue distention. It is always well to attempt to pass this instrument before resorting to filiforms.

In our experience, almost invariably if a filiform has once been passed and tied in for several hours, this whip bougie can be passed and the following treatment of the case much simplified. Very rarely, since this instrument was manufactured, at our suggestion, about ten years ago, have we found it necessary to use the tunnel sound. In our experience, when in possession of the former, the latter instrument is practically no longer required for the purpose of distention of stricture.

In cases in which the stricture proves impermeable, it is well to administer an anesthetic and then repeat the attempt. If this also proves unsuccessful, an operation is necessary. It is rarely necessary to operate for the relief of stricture when filiforms

can be passed. This is a rule to which there are a considerable number of exceptions, generally due to a dense formation of cicatricial tissue, or to the fact that time enough cannot be taken to dilate the stricture in a proper manner. We have purposely not attempted to classify these exceptions, as has often been the custom in the past. We do not wish to encourage the unneccessary performance of operations, and the better the surgeon, the more often can strictures be overcome without incision.

It is not considered desirable or necessary to give here a review of all the various methods of operating for the relief of stricture. They consist, for the most part, of the performance of either internal or external urethrotomy.

Fig. 182.—Greene's whip vulcanized rubber bougie.

Internal urethrotomy is to be performed only when the stricture is at the bulbomembranous junction and when a small silk bougie that acts as a guide, and later on doubles up in the bladder, the end of the instrument being attached at the upper end of the bougie, can get past the obstruction. The instrument ordinarily used for the purpose is called the Maisonneuve, after the French surgeon who invented it. The portion of the instrument above the attachment to the filiform consists of a curved steel sound of a very small caliber, running along the anterior surface of which is a groove; along this groove runs a knife-blade with a very long handle, which projects above the upper border of the instru-

ment. The filiform guide, followed by the instrument without the knife, having been pushed into the bladder, the penis being firmly held by an assistant in such a manner that the urethra is on the stretch, the knife-blade is introduced at the meatus in the groove of the instrument, pushed rapidly down in the groove beyond the bulbomembranous junction, and as rapidly withdrawn. The instrument is now removed and a somewhat stiff, olive-pointed silk catheter of No. 10 or 12 caliber is passed into the bladder; the bladder is washed out through this, and the instrument is then tied in place by means of tape passed around the meatus, being allowed to remain thus for six or eight hours, in order that, by the pressure it exerts, it may tend to prevent hemorrhage. At the end of this time the bladder should again be washed out and the catheter removed. At intervals of every three or four days the stricture may gradually be dilated by the insertion of sounds—either rubber bougie or steel sounds of larger and larger diameter. It is best to use the silk bougies at first, and, when larger-sized instruments are required, the steel sounds, or the after-dilation may be made by the Kollmann dilator. In performing this operation it is wiser to use the smallest of the Maisonneuve knives.

Fig. 183.—Maisonneuve's urethrotome.

Internal urethrotomy may be performed by means of the Maisonneuve instrument, without the employment of general anesthesia, a 2 per cent. solution of cocain being instilled two or three times and allowed to trickle down the posterior urethra into the bladder and remain there. The Maisonneuve instrument is a fairly good one, and has in the past served a useful purpose. At the present time it is rarely, if ever, required in the performance of an internal ure-

throtomy, for if a stricture will admit the introduction of a filiform bougie into the bladder, it can almost invariably, by means of tunneled sounds or otherwise, be so distended that no cutting operation will be required. If these operations—either external or internal—for the relief of stricture at the bulbomembranous junction can be avoided, it should be done. Although the death-rate following these operations is comparatively low, and is probably growing still lower each year, there is always some danger, which should be considered, of so wounding the floor of the prostatic urethra as to render a hitherto virile man impotent.

It was often the custom in the past to incise strictures of the anterior urethra, some of which permitted the passage of large instruments—the so-called strictures of large caliber. Many thousands of such operations were performed. In quite a large proportion of cases deformities of the penis follow the making of too deep incisions in the anterior urethra. Such operations are now performed much less frequently than formerly. Many ingenious instruments were devised for the purpose. That of the late Dr. Fessenden S. Otis is useful for this operation, which is mentioned here not because it is practised by the writers as a routine procedure, but because they consider it an adjunct to external urethrotomy. Dr. Otis' urethrotome carries a sheathed straight knife in a groove cut in the upper end of the instrument. A dial-plate registers the amount of separation effected by means of a screw apparatus. The instrument is introduced and passed by the stricture closed; then distended. When the desired caliber is reached, the knife-handle is lifted, which releases the knife from the sheath, when it can be brought up across as much of the urethra as it is desired to incise, and

Fig. 184.—Otis' dilating urethrotome.

then pushed back into the sheath and the instrument removed from the urethra.

External urethrotomy is the operation generally used when one is required for the relief of stricture. It may also be used for other purposes, such as bladder drainage, prostatectomy, and the like. This operation was performed more often in the past than it is at present, and undoubtedly much more often than was necessary in the attempt to overcome tight stricture of the urethra. When performed with a guide—that is, when the operation is done for the relief of a stricture that is not entirely impassable—it consists of cutting down through the perineum just behind the scrotum, exactly in the median line, upon an instrument, ordinarily a small grooved steel sound, which has been pushed into the bladder or a filiform bougie.

The patient being anesthetized and the operative toilet having been made, the legs are elevated, the testicles pulled up out of the way, and the bulbomembranous region, with the aid of an assistant holding a guide, being rendered as tense as possible over the instrument in the bladder, the incision is made in the manner previously directed, directly over the curve of the instrument in the bladder, which can be felt; it should be kept exactly in the median line and parallel to the shaft of the penis, and should be about two inches long. The dissection should then be carried carefully down until the urethra is met. By keeping the thumb and finger of the free hand on each side of the cut hemorrhage will be largely prevented. Any bleeding points encountered may be tied off as the operation progresses.

The urethra, it must be remembered, if dissected out from the body of the penis, closely resembles in appearance a piece of half-cooked macaroni; being densely surrounded by tissue in the perineum, it does not, however, at first assume this appearance when cut down upon with the knife, but if the dissection proceeds slowly and carefully and the knife-handle is frequently used to push the other tissue out of the way, it is generally fairly easy, even for an inexperienced surgeon, to determine when the urethra is reached. Having been encountered, the urethra should be carefully incised for an inch or two from above downward, a liga-

ture being placed on each side and given to an assistant to hold, so as to keep the incision in the urethra open; an attempt may then be made to examine the urethra further. When a stricture is present, this cannot be done, as the guide that has been placed in the bladder will become tightly engaged in the stricture. This being the case, Arnott's grooved probe director should be pushed along the bottom of the guide, which may be seen running into the bladder, the groove of the instrument pointing downward; then a small, narrow-bladed knife or a Gouley's beaked bistoury should be run along the groove in the director until the constricting bands have been severed. If a grooved sound has been used for a guide, the knife may be run along the groove in the sound. In cutting the constricting band it is possible for an inexperienced operator to wound the rectum. It is well, at this point of the operation, to introduce a finger in the rectum in order to learn if the knife is approaching too closely. The incision having been made, the knife should be withdrawn, followed by the director; then the guide, which has been run down the urethra into the bladder, should be removed, and the forefinger of the operator introduced through the perineal wound into the bladder. As a rule, when the bladder is reached, this will be made manifest by the urine that will flow out of the wound after the incision is made in the urethra through the stricture, and urethra depressed. Before or after the guide has been withdrawn, and after the incision has

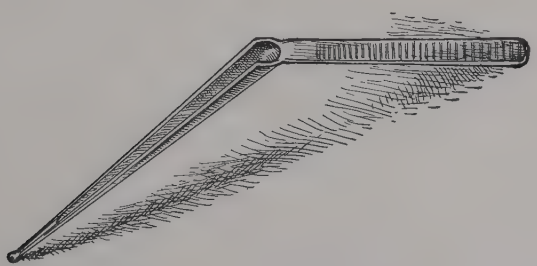


Fig. 185.—Teale's probe-pointed gorget.

been made in the urethra along the director and the director removed, a Teale probe-pointed gorget may be run along the urethra until the bulbous-pointed end reaches the bladder. Although

this is not, of necessity, the instrument to use, ordinarily it makes a good tunnel along which the bladder may be reached. Medical students and surgeons in general will find it an advantage to familiarize themselves with the feel of the prostatic urethra as imparted to the examining finger. So far as this is concerned, when the urethra enters the prostate, the finger running along the canal feels as if it had entered the neck of a bottle or as if it were entering the slightly distended cervix uteri. From the fact that many of the cases that require an external urethrotomy are riddled, as it were, with scar tissue along the bulb and pendulous urethra, it is good practice, the writers believe, when the bladder has been reached and the stricture incised, etc., to insert in such cases an Otis urethrotome, previously described, pushing it down closed through the urethra from the meatus until its end projects through the perineal wound; then, opening it until the index points to the desired diameter,—32 or 33,—in the manner previously described, withdrawing it along the anterior urethra as far as may seem desirable—possibly all the way out. A No. 30 French sound should now be introduced from the meatus downward and allowed to emerge through the perineal opening. If it passes easily, the strictures have probably been incised far enough. If the gorget was used, it should be withdrawn from the perineal wound and a soft-rubber catheter of large caliber introduced into the wound and run along into the bladder. Care should be taken that this does not press too hard against the posterior wall of the bladder, and also that its farthest end is so far to the front as to prevent urine or any fluid injected through it into the bladder from escaping. It can be fastened in by means of tapes tied about it, run around the body in an over-and-under fashion, or two or three catgut ligatures may be inserted through the skin of the perineum and piercing the wall of the drainage-tube. Before the tube is fastened in place,—and this cannot be insisted upon too strongly, whether or not there is hemorrhage,—narrow gauze should be packed around the tube—that portion of it which is in the urethra. The packing may be removed and not replaced in twenty-four or forty-eight hours, and the tube at the end of four days; if de-

sired, it may again be inserted and allowed to remain for three or four days longer. The bladder should be washed out daily through the tube, and before and after the tube is removed considerable attention should be paid to keeping the dressing and the borders of the perineal wound clean. By means of a little glass tube a small piece of rubber tubing can be attached to the perineal tube and the urine allowed to drain off into some convenient receptacle. At the end of four days, when the tube is removed, a No. 30 sound should be gently passed into the bladder. If its end engages in the perineal wound, a finger introduced in the wound will guide its beak onward into the bladder. A catheter should be reintroduced about every four days, and, ordinarily, within a few days after the removal of the tube the patient will gradually become able to urinate through the meatus.

It sometimes happens that a filiform can be introduced into the bladder, but that, on account of the density of the cicatricial tissues, a steel guide or tunneled sound cannot be passed. In such a case pass a small tunneled sound over the filiform as far down the urethra as it will pass; it will generally go pretty well down to the bulb; make an incision in the median line just over its extremity or just below it until the filiform is reached; then, using care not to disturb the end of the filiform that is in the bladder, pull the other end out through the perineal wound; then take a Rand tunneled knife, run the end of the filiform through the opening in it, and push the knife through the constricting bands. After the stricture has been cut and the knife and filiform removed, a Teale gorget can be passed into the bladder. In making the incisions use care to avoid cutting the filiform. This is Rand's modification of Gouley's operation. We

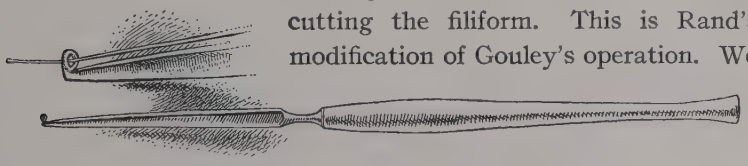


Fig. 186.—Rand's tunneled knife for incision of stricture.

consider the Rand tunneled knife a good modification, from the fact that in a very tight stricture we have found the stricture hug

the filiform so tightly that after the perineal incision it was difficult to pass anything between the filiform and the stricture.

When it is impossible to pass any instrument as a guide, through a stricture, it becomes necessary to do an *external urethrotomy without a guide*. This is a somewhat more difficult procedure, and one that has been widely discussed in the past. It is not always easily and rapidly performed, even by experienced operators. It should be remembered, however, that the surgery of the urethra is a much more familiar subject than it was ten or twenty years ago. Nothing is to be gained by undue haste; on the other hand, however, more serious consequences are likely to result from a too prolonged retention of urine than from the operator making a few unnecessary nicks. It is also well to remember that a suprapubic cystotomy is a comparatively simple operation to perform; that, the bladder being opened, a catheter or guide may be introduced from the bladder along the urethra forward, the perineum being incised to meet it, and in this way the stricture be overcome.

Urethrotomy is performed as follows: A Wheelhouse staff should be passed along the urethra as far as it will go, the crook in its bulbous end pointing outward. The perineal incision should be made over this, and a ligature passed through the urethra on each side, these being held by an assistant; the Wheelhouse staff should then be turned around and hooked into the upper angle of the wound. A triangular opening is thus made close to the site of the stricture. The Wheelhouse staff should form the apex, ligatures holding the wound apart at the corners of the other angles. Now, with a small probe, or, better still, an Arnott's probe-pointed director, push gently along into the wound, when, in a large proportion of the cases, a urethral opening will be found. If this is the case, an incision should be

Fig. 187.—Wheelhouse's staff.

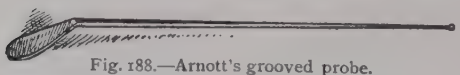


Fig. 188.—Arnott's grooved probe.

made with a small, narrow-bladed knife along the probe or director that has found the opening, and the stricture incised. The remaining steps of the operation are the same as those ordinarily pursued in performing external urethrotomy.

Fig. 189.—Gouley's beaked bistoury.

A surgeon not familiar with the field, on operating for stricture without a guide, will be surprised at the small size of the opening of the stricture ordinarily present in cases requiring the above operation. The urethra having been incised, held up at its apex, and pulled apart by the sutures on the side in the manner suggested above, will present a lozenge-shaped surface to the eye of the observer, some one or two inches long, according to the length of the incision which has been made in it. In the face of this, the opening of the stricture must be looked for very carefully. In our experience it is more apt to be found toward the upper angle of the wound, and when perceptible to the naked eye, exactly resembles the opening of one of Morgagni's crypts, as seen in the anterior urethra. This explanation is made for the benefit of those who have not had experience in this operation, and who, without such experience, might naturally be looking for an opening with a larger mouth than is apt to be present.

If, after patient effort, the operator does not succeed in finding the urethral opening, he should not become discouraged. He must remember that he is searching for the end or some other portion of a white, macaroni-like tube, which issues from a structure resembling the neck of a bottle, runs toward him, and the end of which is very close to the wound. If he so desires, by placing his hand on the abdomen and pushing down, or by having an assistant do so, the neck of the bladder may be brought a little nearer to him. A dissection should then be made, always keeping in the median line, and being careful not to wound the rectum. The perineal wound should be extended and the incision be made deeper and deeper and a little farther down toward the back. If no deflection is made from the median line, the urethra is very certain to be reached by this procedure. A small trocar may be

introduced to reach just back of the stricture. If urine escapes after the stilet has been withdrawn, the perineal incision may be extended to it. Dr. C. L. Gibson, of New York, has suggested that a hook be introduced into the rectum, the prostate hooked, and that then, by exerting traction downward and backward, the urethra will be stretched and more easily made out and reached through the perineum. With one finger in the rectum, a stab-like puncture may be made through the perineum over the seat of the stricture, and the knife-blade pushed forward toward the region of the neck of the bladder, the finger in the rectum being kept at the apex of the prostate to act as a guide. The stricture may be incised anteriorly later.

Other methods failing, two procedures yet remain to be tried: suprapubic cystotomy with retrograde catheterization and the exposure of the urethra through the Senn incision, described further on as a method for reaching the prostate and the seminal vesicles. In order to make this incision it is only necessary to extend the perineal wound a little nearer to the rectum, and then make an incision from the end of the perineal wound running off from each side of the rectum at an angle. The rectum being pulled out of the way as the muscles are incised, the deep urethra and neck of the bladder will be brought into view; it will then be possible to incise the urethra at the desired point.

RUPTURE OF THE URETHRA

Rupture of the urethra is the result of accident or follows a neglected stricture; in the writers' experience it is most frequently due to the latter cause in the hospitals, and is seen in old alcoholics with neglected strictures in whom infiltration into the surrounding tissues has already taken place, forming a brawny swelling behind the ruptured portion, in the perineum, along the inner surface of the thighs, and possibly on the abdomen, over the pubic region. When urinary infiltration has taken place, sloughing is, of course, eventually to be expected. It is astonishing to observe how extensive an amount of infiltration of urine into the surrounding tissues may take place and recovery still follow.

The diagnosis in these cases is comparatively easy; the swelling, with the history of, or the presence of, stricture, pointing to rupture. These cases should be treated as certain other forms of stricture—*i. e.*, by external urethrotomy; for although the urethra is ruptured, the rupture is not often complete, and it will generally be possible to pass a guide into the bladder; free drainage of the infiltrated surfaces should be instituted. It is sometimes necessary to make a large number of incisions. A case of rupture of the urethra coming under the care of one of the writers recovered after drainage-tubes had been inserted in the inner surface of the thigh, lower portion of the abdomen and groin, the tubes running in many directions. Recovery may follow even in those cases in which the after-sloughing is so extensive as to demand a plastic operation for the purpose of covering the denuded surfaces. One of the secrets of success in treating this class of ruptured urethras consists in the careful establishing of free drainage by means of the introduction of tubes through multiple incisions into the infiltrated portions of the tissues.

Rupture of the urethra from injury may be complete or incomplete. If incomplete, as shown by the patient's ability to urinate and painful micturition, or pain in the perineum with hematuria is all that is complained of, nothing should be done but to keep the patient under close observation. Not even a urethral instrument should be passed. If slight perineal swelling takes place but does not increase, it may eventually be incised and clots let out. If well-marked increasing infiltration appears, it should be incised, the urethral opening, if possible, found, and a retention catheter placed in the bladder for a few days. Complete rupture is indicated by the appearance of infiltration, inability to urinate, and probably severe shock. In such cases it is necessary to operate, find the distal end of the urethra, and unite the two ends over a retention catheter. In uniting the two ends of the urethra, where complete severance of the canal has taken place, it should be borne in mind that as few stitches as possible should be passed through the mucous surface of the urethra. It will be necessary to pass two sutures to the right and left of the median line through the mucous surfaces and to tie them on the same surfaces. The other sutures should be passed through the urethra without

invading the mucous surface. Albarran, whose work in this direction has probably been more extensive than any one, states that he considers it possible to get primary union where the urethra has been completely severed, and at the same time to resect as much as $2\frac{1}{2}$ to 3 cm. of the urethra. The method of suturing mentioned is exhibited in figures 182–184. Where in rupture of the urethra the injury has been so excessive as to destroy a larger amount of the urethra, necessitating resection of more than $2\frac{1}{2}$ to 3 cm., if the two ends of the urethra can be brought into the perineal wound and the roofs of the urethra attached as near as possible to one another, union may be eventually hoped to take place along the roof, and the perineal fistula which remains may afterward be cured by plastic operation as described in the article on Urethral Fistula. In other words, a two-step operation may be performed. It may be difficult to find the distal end of the urethra; but, the proximal end being found, the distal end may be searched for in the tissues ordinarily through a longitudinal perineal incision. A drop of blood or a drop of urine may indicate its presence. When not found by longitudinal perineal incision, it may be necessary to find it by exposing the prostatic urethra through the curved perineal incision or some modification of it, as when operating for a prostatic abscess. Severe stricture is likely to result and a guarded prognosis should be given in such a case.

ABSCESS OF COWPER'S GLANDS

These two glands, lying outside the urethra at each side of the bulb, occasionally, but rarely, suppurate. When they do, a one-sided swelling develops in the perineum in the immediate vicinity of the bulb, manifesting a tendency to extend backward toward the anus. Unless both glands are involved, a general brawny swelling of the perineum does not occur. It is commonly believed, at the present time, that abscess of Cowper's glands is almost invariably of tubercular origin, which infection may be, and in such cases generally is, associated with urethritis. If these cases are not seen until some time has elapsed, they resemble the urinary infiltrations that occur as the result of rupture of the urethra. They are also at times easily confused with the effects

of injury or with a simple peri-urethral abscess. We have operated on one case in which no swelling of the perineum could be made out, the main indication being the pain in the perineum suffered by the patient, which was, of course, immediately relieved by the evacuation of the pus.

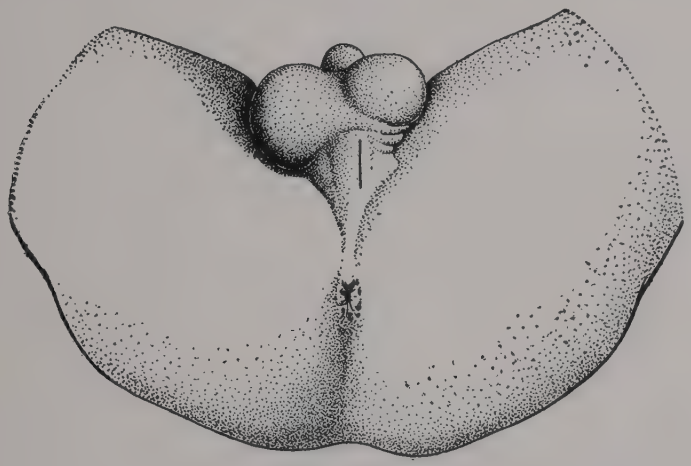


Fig. 190.—Line of incision for abscess containing extravasated urine.

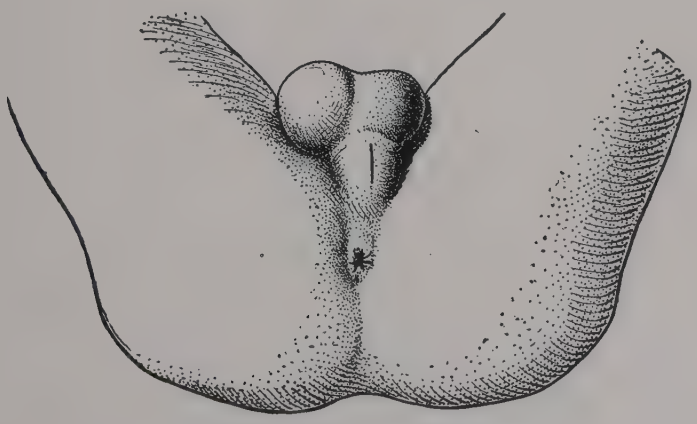


Fig. 191.—Line of incision for abscess of Cowper's gland.

Treatment consists of opening the abscesses at the most prominent protuberance, evacuating the pus, and cleaning out the cavity very thoroughly. If the abscess is really one of Cowper's gland, the hole in which the finger is placed will probably feel

more circumscribed than if some other form of abscess in that locality is present. Urinary tubercular fistula or extra-urethral fistula may result, and the case prove quite annoying. These factors are to be borne in mind in giving a prognosis before operation. They are also to be guarded against by observing the utmost care in cleaning out the cavity. A finger in the rectum may be of aid in indicating the point at which the incision is to be made or curetage performed.

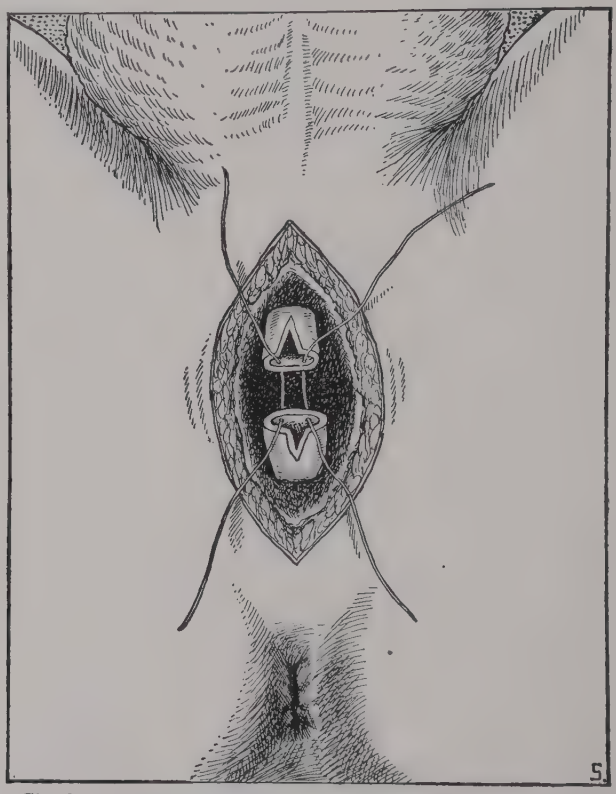


Fig. 192.—Circular suture of complete section of the urethra, showing position of first sutures (redrawn from Albarran).

RESECTION OF THE URETHRA

Resection of the urethra has already been considered to some extent in connection with the subject of complete rupture of the urethra. Resection of the urethra is occasionally performed for the

relief of stricture, particularly in those cases in which there is a large amount of cicatricial tissue in and around the floor of the posterior urethra. It is rarely that resection is performed for stricture in the anterior urethra. Resection is, in the majority of cases, a partial resection. The portion of the urethra removed being situated in the floor of the urethra, a band of connecting mem-

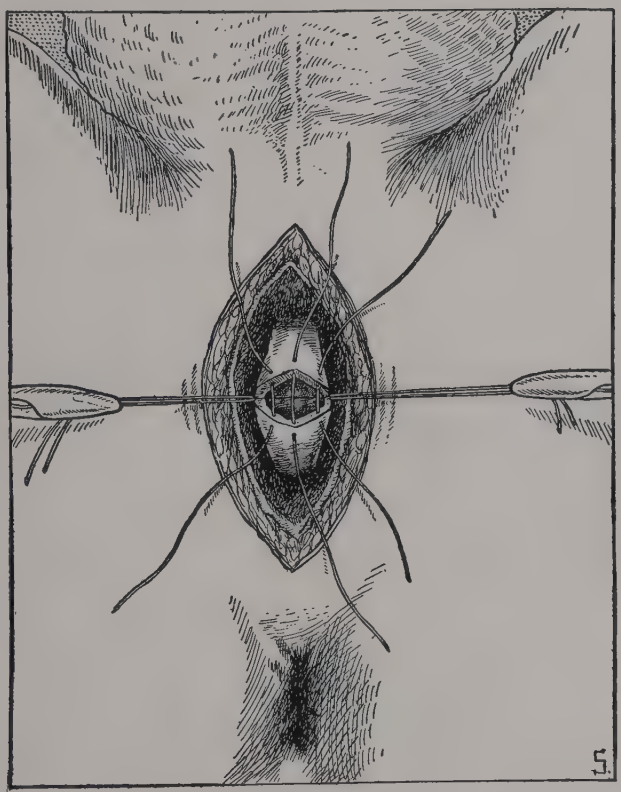


Fig. 193.—Circular suture of the complete section of the urethra, showing positions of suture for side and bottom walls (redrawn from Albarran).

brane is left on the roof of the urethra. An inch or more of the floor of the urethra may be removed if the roof is left intact, and satisfactory union yet take place. The object to be attained in performing resection ordinarily is to get rid of old cicatricial masses and nodules, in the hope that the scar that will necessarily result from the reunion of the severed portions will be softer and

more uniform. After resection of a portion of the urethra, the severed ends may be brought together; if desired, slight longitudinal incisions may be made in the floor, so that the resulting cicatrix will not be too annular and the severed ends made to fit into each other in triangles. It is more generally the cus-

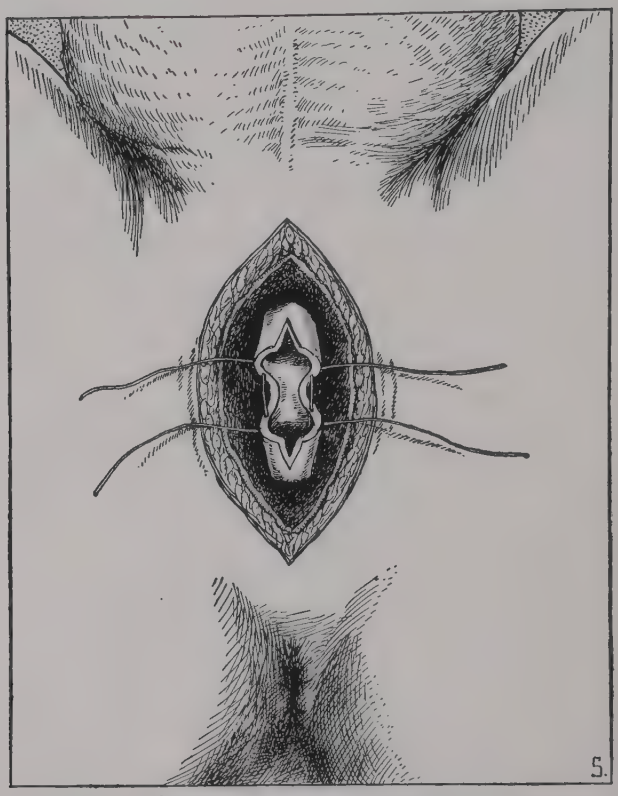


Fig. 194.—Resection of urethra, where a portion of the superior wall has been left, showing sutures (redrawn from Albarran).

tom to make the floor of the perineum serve as the floor of the urethra; one median and an external set, or the mattress form of sutures which does not include the skin, may be employed and the skin wound allowed to heal by granulation. To obtain the best results it is necessary to remove the cicatricial tissue very completely.

OPERATIONS FOR THE RELIEF OF URETHRAL FISTULA

These operations may be considered under three heads: (1) Operations for fistula in pendulous urethra. (2) Operation for perineal urethral fistula. (3) Operation for urethral rectal fistula. Of these, the last is the most important variety.

1. **Urethral fistula in a pendulous urethra** may be operated upon by a method similar to those pursued when the fistula is in the perineum, or by the methods recommended for the relief of hypospadias. If it is deemed advisable, a plastic operation may be

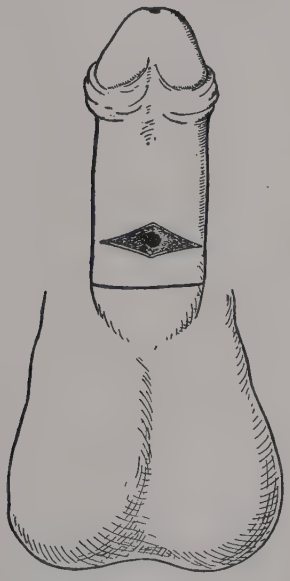


Fig. 195.—Urethral fistula; skin freed by transverse incision.

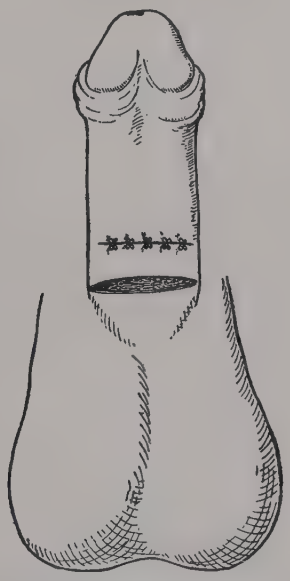


Fig. 196.—Skin freed by transverse incision and fistula closed by sutures.

performed. The illustrations (Figs. 195 to 200) give an idea of the methods most in vogue. Diffenbach, to avoid pressure on the line of suture, makes two lateral incisions, one on each side of and one parallel to the wound, thus permitting the borders of the cut to unite without too much strain.

Several other methods of operating for the relief of this condition have been devised. They consist of the making of various forms of flaps. The persistence of erections increases the difficulty of uniting wounds; and may necessitate a perineal incision in order to anchor the urethra at the fistulous portion.

2. **Operations for Perineal Urethral Fistula.**—Resection of the uretha, together with removal of any cicatricial tissue remaining in the perineum, is a method that may be employed for the relief of perineal urethral fistula. Resection of the urethra may be performed in the same manner as is done for the relief of stricture. Another method of operating for perineal urethral fistula is to place a guide in the bladder, incise the fistulous portion on the guide, carefully remove any cicatricial tissue in the region of the fistula, sew up the incision in the urethra with fine catgut, not permitting the stitches to go through the inner coat of the urethra, and either allow the patient to urinate naturally or permit a retention catheter to remain

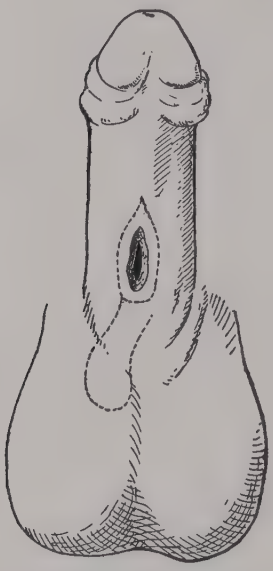


Fig. 197.—Urethral fistula; edges freshened and fistula covered by scrotal flap.

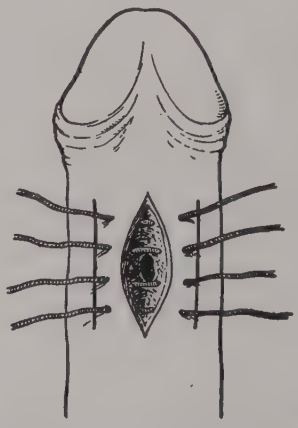


Fig. 198.—Repair of urethral fistula; edges freshened, side incisions to overcome retraction of skin. Sutures placed but not tied (Berger and Hartmann).

in the bladder for a few days. Another set of stitches is taken, as desired, through the exterior perineal tissue. This is the simplest method of operating for the relief of these fistulas.

In the writers' experience, however. this operation has not been so satisfactory as could be desired. They have seen these fistulas most often in hospital patients, and particularly in tuberculous subjects. Such patients have poor reactive powers and do not retain retention catheters well, as their mucous membranes are very easily irritated. The most practicable method, the writers believe,

of operating on a perineal urethral fistula, as it ordinarily presents itself, was devised by Dr. Fraser, of Brooklyn, an associate of Dr. Henry H. Morton, of the same city, to whom we are indebted for the suggestion. The procedure consists in clearing away the cicatricial tissue surrounding the fistula, introducing a sound into the bladder, and then, a retention catheter having been placed in position, sewing up the perineal tissues with deep silver wire sutures which reach to, but do not go through, the urethra. These sutures are allowed to remain in position for a week or ten days, and are useful for holding freshened edges of the perineal tissue together so that complete union, to a very great extent, may take place; the slight oozing remaining after the removal of the sutures generally disappears in a few days. If a plastic operation seems required on one side of the urethra, have a quadrilateral flap resected in such a manner that by turning it over its cutaneous face becomes internal, constituting the inner wall of the future canal. A second flap with its base external is cut from another lip of the canal and made to recover the cutaneous surface of the first turned over flap, and the borders of this flap are fastened in such manner as to cover the bleeding surface created by turning back the first flap. If a small fistula remains following this, it may later on be cured by freshening its edges.

Fig. 199.—Urethral fistula; edges freshened, side incisions, sutures tied (Berger and Hartmann).

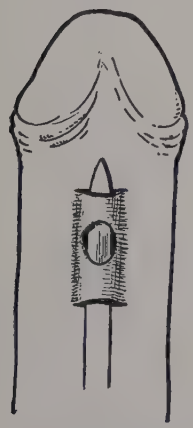


Fig. 200. — Urethral fistula; liberation of skin by the aid of two transverse incisions, method of Nélaton (Berger and Hartmann).

3. **Operations for the Relief of Urethro-rectal Fistulas.**—These fistulas have, until recently, been rarely reported. Ordinarily, they are due to injury from within the urethra, owing to improper instrumentation, or they may be due to accident from without. In a case recently under the writers' care, it was caused by injuries sustained during an explosion of dynamite. Within the last few years,—*i. e.*, since operations

through the perineal roof for the relief of prostatic hypertrophy have become so common,—urethrorectal fistulas have increased largely in number mostly following this operation.

Diagnosis.—This is easily made from the fact that, generally, a portion of the urine is voided through the rectum, flatus and occasionally liquid feces being passed through the penis. With a sound in the bladder and a finger in the rectum, the latter may be pressed on the surface of the sound, which presents itself with-

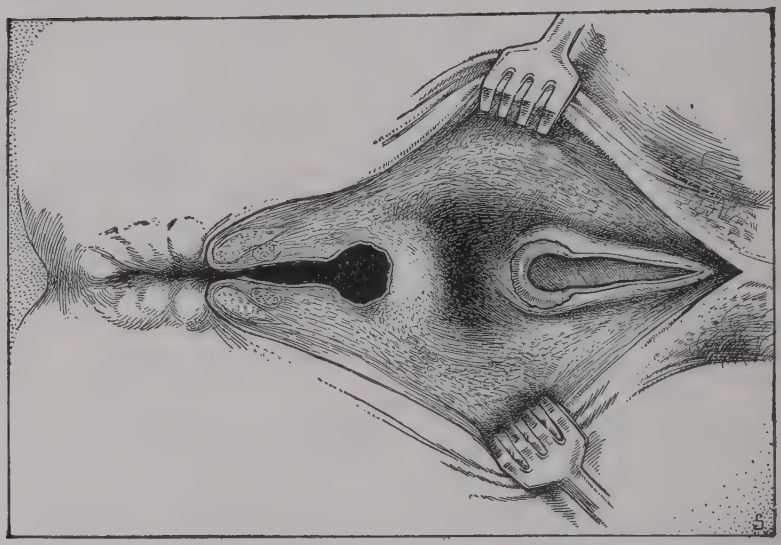


Fig. 201.—First step of Tuttle's operation for repair of recto-urethral fistula.

out offering any impediment to the finger, and the size of the fistulous opening may thus be made out.

Prognosis.—If, immediately after an injury, the fistulous opening in the rectum is found to be no larger than a ten-cent piece or a copper cent, the prognosis is good, complete recovery ordinarily following the adoption of simple measures. If the urethrorectal opening is large, the prognosis is doubtful.

Treatment.—There are three methods of treatment: palliative, local, and operative. The *palliative* treatment consists in the patient using the greatest care in regard to his diet, guarding against constipation, and, above all, against diarrhea.

He must also observe the utmost cleanliness of that portion of the rectum that may extend from the anus to the fistulous rectal opening. The best means of securing this is by ordering rectal injections of some mild cleansing wash, such as a weak solution of some mild antiseptic.

Local measures consist in the introduction of a Kollmann dilator into the bladder through the urethra at the meatus at intervals of four or five days, and the gradual overdistention of

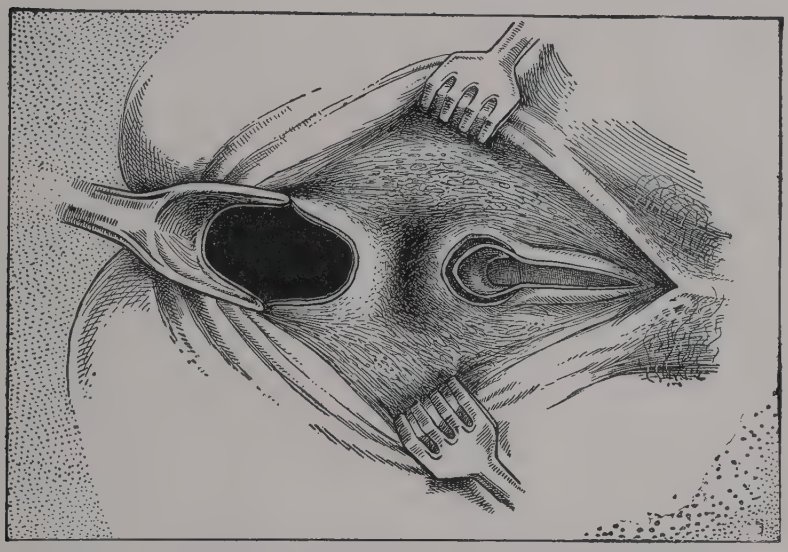


Fig. 202.—Second step of Tuttle's operation for repair of recto-urethral fistula.

the prostatic and membranous urethra. If possible, the dilatation should be continued until a caliber equaling that of No. 45 F. has been reached. If a Kollmann dilator is not available for this purpose, steel sounds may be used. In passing either the sound or the dilator, however, great care must be observed to see that the beak of the instrument does not enter the rectal opening through the urethra instead of entering the bladder. The patient himself will generally be aware of it when this occurs. To obviate this it is best to proceed slowly, to hug the roof of the urethra closely, and, while passing the instrument, to insert a forefinger into the rectum in order to learn when the beak of the instrument

enters this, and to help to guide it upward and outward on its way to the bladder. Such remedial measures as cauterizing the edges of the fistula, either in the rectum or the perineum, have proved useless in the writers' hands.

Operative Treatment.—Although a number of operations have been devised for the relief of this condition, one that, in the writers' experience, has been followed by good results, is that of Dr. James P. Tuttle, of New York city. This is performed as follows:

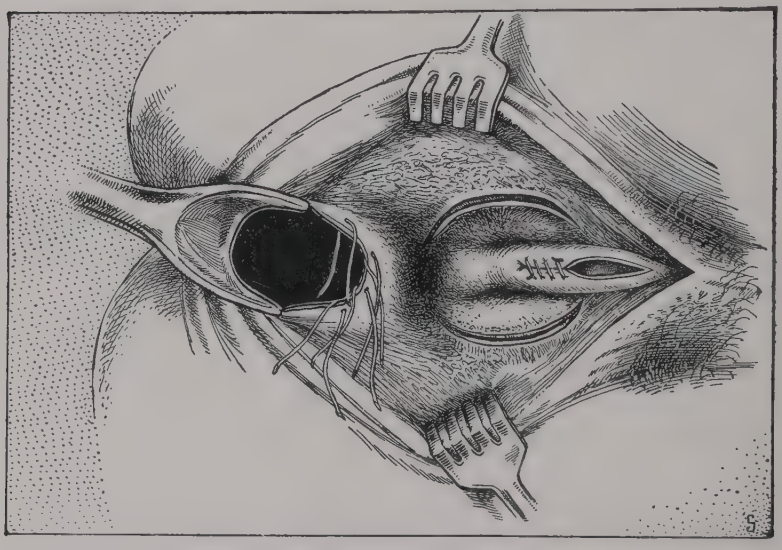


Fig. 203.—Third step of Tuttle's operation for repair of recto-urethral fistula.

Tuttle's Operation for Closure of Recto-urethral Fistula.—First: The operation should not be undertaken until suppuration in the bladder, the urethra, and the fistulous tract has completely disappeared.

Second: All strictures of the pendulous urethra should first be thoroughly dilated.

Third: The operation should be preceded by a week's course of urotropin and intestinal antiseptics.

The Operation.—With the patient in the Sims posture, the hips being well elevated, the urethra is laid open from the scrotum back to the fistula; the incision is then carried through into the

rectum, thus making an opening that reaches to the fistula. The latter is then dissected up from the rectal side and left attached to the urethra. The rectum and urethra are next separated transversely well above the fistula, so that the anterior rectal wall can be dragged down over the fistula to the anal margin. The mucous membrane is then dissected from the anal margin on each side of the wound and trimmed off, so as to form a crescent with the edge of the gut that has been separated from the urethra above the fistula. A soft rubber No. 22 F. catheter is now passed from the meatus into the bladder. The edges of the fistula are

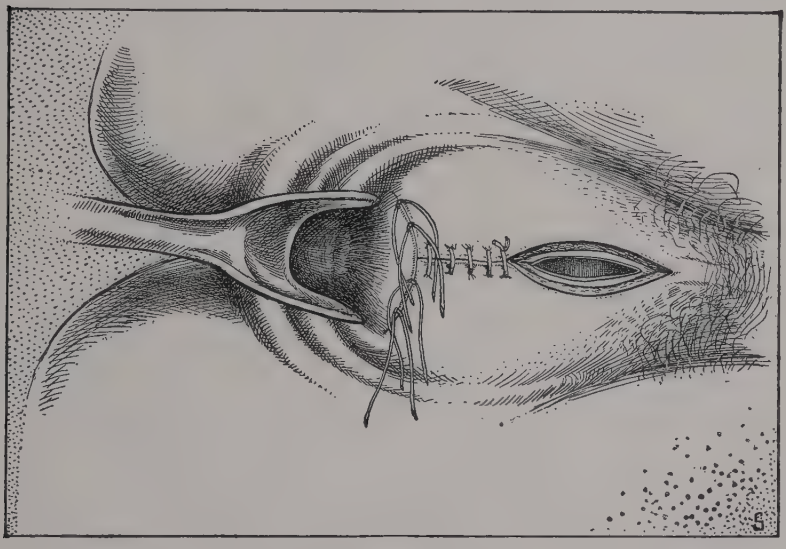


Fig. 204.—Fourth step of Tuttle's operation for repair of recto-urethral fistula.

then inverted, and their freshened surfaces sutured together with No. 1 ten-day chromicized gut, the continuous Lembert suture being employed. The urethra is thus closed down to one half inch below the level of the external sphincter ani. The remainder of the perineal wound and urethra are left open. Reinforcing flaps are then cut from the perineal tissues on each side of the sutured area, and brought together over the first line of sutures by a continuous chromicized suture. A silkworm-gut suture is then passed through the skin from one side of the anus up through the perineal tissues to the apex of the wound, through

the muscular wall of the gut at this point, and back through the perineal tissues and skin on the opposite side, the ends being left untied. The anterior wall of the rectum is then brought down and sutured to the margin of the anus, from which the mucous membrane was dissected, thus forming an impervious layer between the sutured urethra and the rectal canal. Finally, the silkworm-gut suture, which acts as an anchor to the rectal wall, dragging it down and preventing tension on the marginal sutures, is tied firmly over a small roll of gauze, so that it will not cut into the skin. The perineal wound is then packed, and the catheter fastened at the meatus, so that it cannot slip out. The catheter is left *in situ* ten days or more. When it is taken out, a perineal fistula remains that usually heals in about three weeks.

CHAPTER XXIII

THE FEMALE URETHRA

ANATOMY

The female urethra is considerably shorter than that of the male and it virtually represents but the posterior portion of the male passage. It is about one and one-half inches in length, but varies considerably in this respect in different subjects. Its walls are ordinarily in immediate apposition, but when its longitudinal corrugations are distended the passage is about one-fourth inch in diameter. The tube can be greatly dilated, however, sufficiently so as to permit the introduction of a palpating finger.

The organ lies embedded in the anterior vaginal wall and its external orifice is found about one inch posterior to the glans clitoris. It passes upward and backward, joining with the walls of the bladder and draining this cavity at its most pendent portion, the trigone. The internal or cystic orifice is stellate in the resting condition and the external orifice or meatus presents itself between the nymphæ as a vertical slit with slightly raised margins. The urethra penetrates the triangular ligament and is attached to the pubic arch by the pubovesical ligaments. The body of the tube is inclosed by the compressor urethræ muscle. The ducts of Skene enter the urethra just within the meatus. These gland tubules are of considerable importance, since in infectious diseases of the female urethra they afford lodgment for micro-organisms which may later infect the bodies of the glands and excite a persistent inflammatory disease with sporadic outbreaks of adjacent infection.

The walls of the urethra are made up, beginning from within, of a thick layer of transitional epithelium, continuous with that lining the bladder and like it in its appearance; at the external meatus this epithelium becomes transformed into a form like that making up the external genital mucosa. At the vesical

extremity of the channel many mucous glands are found, the ducts of which enter the urethra at this point. The mucous membrane of the urethra is laid down on a delicate basement membrane which is in turn applied to a thick and very highly vascular connective-tissue coat which is further characterized by the presence of many elastic connective-tissue fibrils. The connective-tissue layer is inclosed by an inner longitudinal and an outer circular layer of smooth involuntary muscle which acts as and receives the name of the compressor urethræ muscle. The muscular coat is united to the surrounding structures by a layer of connective tissue which blends with the surrounding stroma.

The lymphatics of the upper portion of the urethra drain into the internal iliac nodes, but the lower ones enter into the channels of the external genitals and so pass to the inguinal nodes. The blood-vessels and nerves are very abundant and are derived from the same sources as those supplied to the vagina.

CONGENITAL MALFORMATIONS

Congenital malformations of the female urethra are more rare than in the male. They are usually found associated with accompanying malformations of the genitals. Atresia is the most frequent congenital malformation with which the obstetrician and general practitioner meets. Its treatment is obvious and the severity of measures necessary depends on the degree of the atresia. Occasionally the urethral meatus is indicated and the septum separating it from the bladder can be perforated by a probe or sound. When no such landmarks exist and where the tube cannot be felt, it may be necessary to open the bladder suprapubically or through the vagina, following later with a reparative or constructive plastic operation such as is indicated by the associated lesions of the particular case under question. Hypospadias and epispadias are very rare and exstrophy of the bladder is also less frequent than in the male. The treatment of these conditions has been sufficiently discussed under the like conditions in the male.

Traumatisms of the urethra are much less common in the female than in the male on account of the protected location of the canal. As a rule, they result from direct violence, and the

chief difficulties presented in their treatment follow from their close proximity to the genital tract and the rectum, from which infections are likely to arise.

Treatment is directed mainly toward surgical repair, when necessary, and toward the prevention of septic infection. On account of the great vascularity healing generally takes place rapidly.

EXAMINATION OF THE FEMALE URETHRA

On account of the short length of the channel, its dilatability, and its accessible position, examination of the female urethra is a much more simple matter than that of the male. Palpation of practically the entire length of the passage can be usually satisfactorily performed through the anterior vaginal wall, the index or examining finger being introduced for that purpose into the vagina. In this manner, calculi lodged in the lumen may be readily detected, and in most cases the location and extent of strictures or new-growth formations can be ascertained.

Examination of the mucous membrane can be best accomplished by the introduction of a small sized Kelly cystoscope, and as the instrument is slowly withdrawn the walls of the canal fall together over the open end of the instrument, when they can be closely inspected bit by bit as the tube is slowly withdrawn. A strong light is necessary and the best results are obtained when light reflected by means of a head mirror is employed. Where Kelly's instrument is not available examination can be quite satisfactorily accomplished with an ordinary urethral endoscope of large size. In the withdrawal of the tube one must particularly inspect the openings of the gland tubules, which appear normally as minute, yellowish, slightly pink spots. Inflammatory and ulcerative processes are especially apt to be seen at these points. The entrance of the ducts of Skene's glands appears just as the instrument is about to escape from the urethra. Where infection of these glands is suspected, massage along their course may force a droplet of discharge into the urethra, from which it may be collected for examination by means of an applicator. Absolute asepsis is, of course, requisite in every step of the examination.

STRICTURE OF THE FEMALE URETHRA

Strictures of the female urethra are rare as compared to the like change in the male canal, still they are present much more commonly than is generally thought to be the case. A stricture of considerable degree may exist without attracting the especial attention of the casual observer, since unless it be very marked or accompanied by acute inflammatory changes, the symptoms complained of are few and considerable retention of residual urine may sometimes exist for a long time in women without attracting the attention of the patient.

Strictures most commonly follow previous inflammatory disease of the urethra, in the cause of which, as in the male, gonorrhea leads in frequency. Tubercular or syphilitic ulcerations are, however, by no means unknown, and strictures following traumatism in child-birth are relatively common. They are very apt to occur with new-growths of the urethra or in the course of neoplasms of adjacent parts, also from inflammatory or ulcerative disease of the vagina or vulva.

Diagnosis.—Diagnosis is usually readily effected, by digital examination through the vagina, when a thickened node of infiltration or fibrosis may be detected; quite frequently it is first discovered through attempting to pass a catheter. The use of the ordinary male sound is not satisfactory for the detection of the stricture, for in nearly all cases the lumen can be so readily dilated as to permit the passage of such an instrument. The olive-tipped sound should be used, and unless very slight the passage of a stricture by one of these instruments can be very easily detected by the practised hand.

Treatment.—Treatment follows along the same lines as employed in the male. The most efficient is the use of graduated sounds or bougies. Dilation can be well effected under cocain anesthesia, or in less marked cases without any anesthetic whatever. Rapid dilation must not be practised, and of course rigid asepsis is to guard every step. Where extensive ulceration, as in new-growths of the parts, or where a large amount of cicatricial tissue causes a stricture near the external meatus, it may be found better to form an artificial meatus in the anterior vaginal wall. The

portion of the tube posterior to the stricture should be brought down into a vaginal incision and its mucosa stitched to that of the vagina. A catheter must be left in position until union has taken place.

These strictures sometimes show a marked tendency to recur, and it is frequently necessary to redilate from time to time. In every case injury to the tissues must be carefully avoided or inflammation and subsequent formation of more cicatricial tissue may follow.

DILATION OF THE URETHRA

Relaxed or patulous urethra is not uncommonly seen in women. As a rule, incontinence of urine does not follow, but in some cases the relaxation may be so marked as to prevent normal retention and operative relief may be imperative. In some cases prolapse of the mucous membrane may take place and a condition simulating hemorrhoids in a small way may appear.

Dilation of the urethra most commonly follows overstretching of the tube, perhaps in unskilful endoscopy, in the extraction of a cystic calculus or occasionally where the entire tissues of the parts are relaxed as a result of some general or local disease. Dilation of the urethra, often to great size, is occasionally seen in cases where, owing to malformation or agenesis of the vagina or external genitals, persistent attempts have finally dilated the urethra up so that coitus through this channel is possible. The authors have seen two such cases; in neither, however, did the patient experience any resulting difficulty, nor were they aware of anything abnormal in their condition. Kelly states that, as a rule, these cases do not complain of incontinence, and he advises letting the condition alone except where the normal genital channel can be established, when the urethra commonly contracts down considerably.

Treatment.—As just mentioned, certain cases demand no treatment. Where prolapse of the mucosa has taken place, the protuberant tissues are to be cut away and the edges of the wound carefully sutured to the normal mucosa. Where the condition is due to relaxation of the surrounding parts or to traumatism, interference may be necessary and the surplus tissue may be removed surgically. A properly fitted hard-rubber or glass vagi-

nal pessary may in some cases sufficiently replace the tissues so that operative procedure may be obviated or at least delayed.

URETHRAL FISSURE

This is a condition of rather frequent occurrence. It consists in a fissure or crack in the mucous membrane which usually extends longitudinally to the lumen. It may be caused by rapid dilation, or more frequently it follows mild or catarrhal types of urethritis. The condition is often very painful and may cause considerable irritation. It is readily detected from the history and on examination of the urethra. It may be treated by the application of silver nitrate in from 3 to 7 per cent. strength; in certain aggravated cases careful dilation of the urethra must precede the treatment. Occasionally we have found it necessary to repeat the treatment for a considerable time before complete relief was afforded. As a general thing these fissures are associated with more or less urethritis and sometimes with cystitis.

PERI-URETHRAL ABSCESS

Abscess formation occasionally occurs about the female urethra. As a rule, it follows urethritis with infection of the urethral glands, and it is commonly gonorrheal in origin. Sometimes these abscesses occur as a result of tubercular or syphilitic ulcerations of the urethra. They may point into the urethra, or may appear as a bulging sac on the anterior wall of the vagina. Their treatment is naturally incision and drainage.

URETHRITIS

Urethritis is probably as frequent in the female as in the male, but in most cases its course is so mild that it appears but as an incident in the course of a vaginitis or vulvitis, and often escapes the observation of the physician. It is caused most commonly by the gonococcus, but may follow infection with any of the various infectious agents or it may result from traumatism. In the last mentioned cases, unless complicated by subsequent infection or by stricture, the progress is toward recovery and the course of the disease is short.

Some cases of urethritis, especially some cases of gonorrheal

infection, are very resistant to treatment and are often most distressing to the patient. The appearance of the mucous membrane varies from bright pink to deep purple in color. Eversion and swelling of the mucosa at the meatus may be seen and an abundant discharge is usually present. Where infection of the ducts of Skene's glands is, as is most commonly the case, present pus can be expressed from them by massage through the vagina. Microscopic examination of the exudate is always advisable in these cases in order that the definite etiologic agents may be demonstrated.

Ulceration of the urethra is very prone to occur in acute urethritis, and, as in the male, stricture is apt to take place with healing of the ulcer.

In chronic urethritis, as a rule, the entire surface of the membrane is not involved and the parts are not so tender but that they may be satisfactorily examined and treated through the endoscope. Patches of redness, of superficial ulceration, or of edema are seen and direct applications to the diseased surface are often possible.

Treatment.—The treatment in general follows closely along the lines outlined for the treatment of the like condition in the male; the disease as a general thing, however, responds much more readily to treatment. In many cases, owing to the shortness of the canal and the less complicated nature of the mucous membrane, the disease is self-limited. Many cases take place and become cured without even the knowledge of the physician or particular complaint on the part of the patient. This is especially frequent when the adjacent parts are the seat of a more active inflammatory process, as in gonorrheal vaginitis and vulvitis.

One of the first steps in the treatment is the rendering of the urine bland by the use of large amounts of water and perhaps by administering alkalis. Beyond question a certain number of cases are set up by an intensely acid urine. Warm sitz-baths are often of great benefit, not only in the cure of the disease but also in relief of its most annoying symptoms. Where severe pain occurs on passing the urine, it may often be voided with comparatively little distress while in the warm bath. Local applica-

tions of various sedative and astringent lotions to the external meatus are often beneficial, and of such the familiar "lead and opium wash" is one of the best.

As a rule, we have not found local irrigation of the membrane advantageous in acute cases. Irrigation in this stage of the disease is very apt to cause infection of the bladder and cystitis. General measures suffice in most cases at least until the exquisite tenderness has subsided, when direct applications of silver nitrate in a strength varying from 3 to 10 per cent. may be made to the mucous membrane. Protargol or argyrol act better in the more acute cases, especially where marked edema is present. In some patients where the inflammation has extended from the urethra into the bladder, where it is frequently located just at the trigone or about the urethral orifice, it is good practice to first irrigate the urethra with a mild solution of potassium permanganate, protargol, or silver nitrate, and then to inject a small quantity into the bladder, where the patient should retain the fluid for a few moments before it is voided.

Chronic cases are to be treated very much along the same lines, but here, as a general thing, direct applications to the diseased portions of the mucous membrane are possible through the endoscope and stronger solutions are necessary.

Throughout the entire treatment of both acute and chronic urethritis attention must be paid to the general condition of the patient and the administration of tonics and a properly adjusted diet are often essential for rapid recovery.

TUMORS OF THE FEMALE URETHRA

Tumors of the female urethra are not common except where secondary invasion of the urethra has taken place from neoplasms of the vulva, vagina, or uterus. Primary neoplasms appear most commonly about the external meatus, where diagnosis is easy, and as a rule the nature of the growth is sufficiently evident on mere gross inspection, though postoperative microscopic examination is necessary for certainty and for proper postoperative treatment. The tumors are conveniently divided for discussion into malignant and innocent.

Malignant Tumors.—*Carcinoma* is the most frequent malignant

tumor of the urethra; it is, however, rare as a primary growth. It is seen most often as an epithelioma of the squamous celled type, originating, when primary, from the mucosa of the meatus, as a rule. The malignant character of the growth may be recognized by its tendency to infiltrate, by superficial necrosis, and by the pain which accompanies it, though the parts are generally not very sensitive locally. As a general thing the gross appearance of the growth is such as to leave little doubt as to its nature. Carcinoma of the urethra is in our experience most commonly confused with syphilitic ulcerations. Differential diagnosis must rest on the Wassermann reaction response to syphilitic treatment and on microscopic examination.

Sarcoma of the urethra is very rare except in general or local sarcomatosis.

Treatment.—The treatment in malignant tumors of the urethra is early extirpation in all cases whenever this is possible. The incision should include as much of the surrounding tissues as practicable, and we strongly advise the discrete application of the *x*-ray after the surgical removal of these growths. Care must be taken in the use of this agent, however, and it should not be employed about these delicate mucous membranes except in the hands of an expert.

Innocent Tumors.—The most frequent innocent tumors of the female urethra are condylomata. They appear as more or less pediculated papillomatous masses, generally in groups and more or less symmetrically arranged, for they are autoinoculable. They probably bear a direct relationship to uncleanliness and in many instances are the result of venereal inoculation. They are ordinarily painless except in secondary inflammation; they grow rapidly, particularly under conditions of moisture and filth, and may develop to tumors of considerable size. The treatment consists in removal, and the surgeon should be particular to fully excise the base of the growth, and the wound should then be cauterized with strong silver nitrate solution.

Urethral caruncles are tumors developing from the lips of the external meatus. They are deep purple in color, due to the large number of blood-vessels which enter into their structure. They may be either pediculated or sessile. They are covered over by a

delicate reflection of the mucous membrane, bleed readily, and are exquisitely tender. They cause great distress, especially on urination or from chafing or pressure. They may further become intensely inflamed. Microscopically they are made up of a delicate connective-tissue stroma which supports a very abundant number of large, thin-walled blood-vessels. The tumors are probably inflammatory in origin; they do not recur on removal and never grow to be of large size.

The *treatment* consists in removal, which must be done under efficient local or general anesthesia. In nearly all cases removal by the knife is to be greatly preferred to cauterization, both because the pain during and after the operation is less and also because the resulting scar after excision is much smaller and better placed than when removed by cautery.

Polypoid fibroma are occasionally found attached to the urethral lips or projecting from the tissues immediately internal to the meatus. The mass of the tumors is made up of myxomatous or embryonal connective tissue and they are covered in by a reflection of the urethral mucosa. Blood-vessels are not numerous. The tumors may cause considerable obstruction of the urethra at times, but unless they become much inflamed they are generally painless. Treatment consists in removal by cutting them away at the pedicle or by twisting them off at this place. They do not recur.

CHAPTER XXIV

THE PENIS

INJURIES OF THE PENIS

Treatment.—Generally speaking, injuries or wounds of the penis have a tendency to heal rapidly. It is not deemed necessary to enumerate here the various injuries or wounds of this organ that have been recorded from time to time. The organ may be completely or incompletely severed or portions of it may be torn away. When completely severed, the ordinary surgical measures for arresting hemorrhage should be adopted and a good stump made. When incompletely severed, the aim should be to preserve the integrity of the urethra as much as possible by means of deep and superficial sutures, placing the organ on a splint, and establishing either perineal or suprapubic drainage and adopting such other measures as will give the injured organ a chance to heal. An astonishing amount of the outside skin may be torn away and repair still take place. If much of the skin surrounding the penis has been destroyed, autoplastic measures may be attempted. These may be divided into two classes: First, when a large portion of the skin has been lost and scrotal tissue can be used, and, second, when a large portion of the skin has been lost

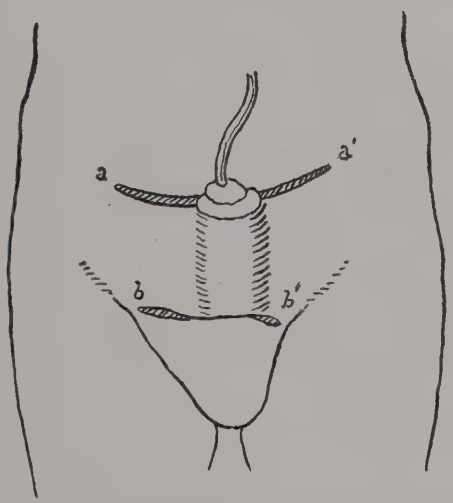


Fig. 205.—Operation of Bessel-Hagen for the plastic repair of denudations of skin of the penis where a scrotal flap cannot be obtained. First step, bridge is taken from the abdominal wall and penis inserted through it (redrawn from Berger and Hartmann).

and scrotal tissue cannot be used. When the skin on the inferior surface of the penis, extending to the scrotum, is lost, the foreskin, if intact, may be split, and a portion of this may be used. Reich's method, shown in fig. 207, consists of making a bridge from the scrotal tissue. Twenty days afterward the bridge is freed by making an incision on each side. When possible, the skin from the scrotum is used.

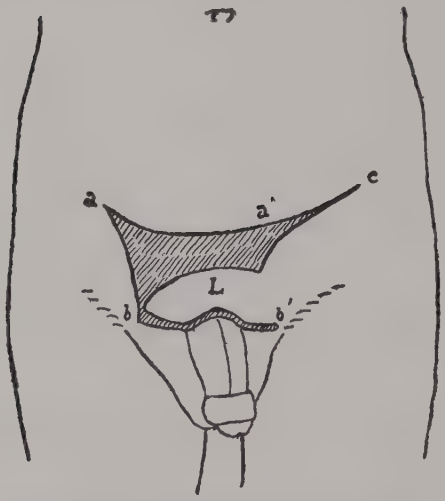


Fig. 206.—The second step in the Bessel-Hagen operation. Eleven days after first operation the line *a b* and *a' b'* is cut through to recover the denuded penis. Then a flap L is made following on lines *a a' c* with which the denudation at the base of the penis is covered (Berger and Hartmann).

Bessel-Hagen'smethod is illustrated by figs. 205, 206. When skin from the scrotum is lacking, the penis is made to pass under a bridge cut from the belly.

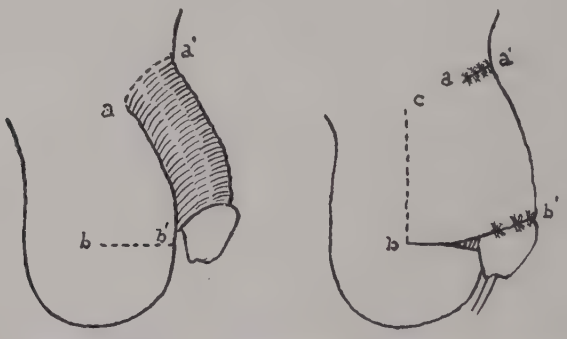


Fig. 207.—Operation of Reich for the plastic repair of denudations of the skin of the penis by means of a bridge of scrotal tissue, *a* and *a'*, *b* and *b'* representing the upper and lower borders of the incision; lower, about 9 centimeters, slightly the longer. The flap having been freed, the surface of denuded shaft of the penis having been freshened is slipped through as though a ring and fastened with a few sutures through top and bottom to the flap. After about twenty days the ring is freed by incising line *c b* (redrawn from Berger and Hartmann).

Eleven days after he cuts each side line, *a b* and *a' b'*. He uses the sides of the bridge and recovers with it the shaft of the penis;

then he takes another flap and recovers with that, line *a a' c*, the base of the penis.

Fracture of the organ may take place; this is in reality a fracture of the corpora cavernosa. The injury is accompanied by pain and sometimes by fainting; the organ becomes flaccid and enormously swollen. Occasionally this is complicated by a rupture of the urethra. As a rule the injury is followed by disturbance of the sexual functions, as after healing the posterior portion of the organ may become rigid at times, the anterior generally remaining flaccid.

Probably the best treatment, if the case is seen early enough, is to cut down on the organ, remove any clots, and, by means of fine sutures, sew the fractured portions well together, applying splints, and preventing, so far as possible in the after-treatment, the formation of cicatricial tissue.

Fig. 208.—Epithelioma of the foreskin. (Natural size.) From a specimen in the museum of Carnegie Laboratory.

GROWTHS AND ULCERATIONS OF THE PENIS

Saddle-shaped nodules occasionally form in the corpora cavernosa and spongiosum, and interfere with the proper performance of the sexual function. They generally occur in men past middle life, and there is much diversity of opinion regarding their origin. They may be syphilitic, gouty, or possibly, in certain cases, malignant. If syphilis is suspected, internal and local external treatment should be tried; antiphlogistic treatment of various kinds may also be effective. If these fail to effect their removal, surgical measures should be undertaken, but a guarded prognosis should be given as regards recovery of the lost sexual function.

Tumors of the organ, with the exception of carcinoma, are rare. Horny excrescences and cysts of varying size occasionally form,

and are treated as successfully as are cystic formations occurring elsewhere in the body. *Cancer* of the penis originates from the epithelium of the glans in most cases; it occurs almost exclusively as a primary growth of the epitheliomatous variety, and is seen only rarely as a metastatic process. The treatment is early and complete surgical removal, and temporizing measures should be adopted only in inoperable cases. Ulcerations on the glans penis are quite common, generally being either chancre or chancroid, for a detailed description of which the reader is referred to any of the text-books on syphilis. Gumma also occurs, usually as an ulcerative process, and where diagnosis is in question, antisyphilitic treatment is always advisable in cases of ulcerated neoplasms of the penis. Tubercular ulcerations may occur, but are very rare. They should be treated by appropriate destructive agents, such as carbolic acid, followed by astringent dusting-powders. Ordinarily chancre and chancroid, except of the phagedenic type, yield readily to local treatment, such as applications of carbolic acid or dusting-powders like aristol, together with the appropriate internal treatment. Chancroid is the principal cause of suppurating inguinal glands, or bubo, which may be mentioned here. *Bubo* is the term applied to an inguinal gland which has suppurated. The treatment of this condition is preventive and operative. The preventive treatment consists in the application of vasogen-iodin or mild mercurial ointment or applications of alcohol on gauze covered with rubber tissue, together with rest in bed. If suppuration takes place the gland should be

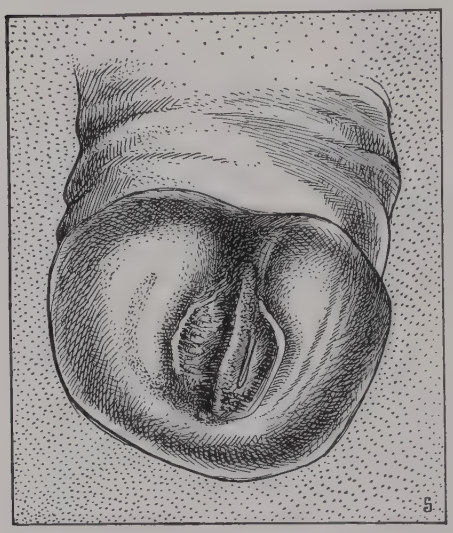


Fig. 209.—Tuberculosis of the glans penis (Frisch and Zuckerkandl).

opened by means of as small an incision, half an inch or more, as is practicable, pus evacuated, and iodoform, 10 per cent. in glycerin, injected three times into the cavity, injection to be repeated on following day and again in four or five days if required. A wet dressing is to be kept applied. In obstinate cases it may be necessary to make a large opening and curet the cavity.

Fig. 210.—Cancer of penis and scrotum (author's collection).

FOREIGN BODIES IN THE URETHRA

The literature bearing on foreign bodies and urethral calculi in the urethra is very extensive, and the methods recommended

Fig. 211.—Thompson's urethral forceps.

for their removal are numerous. If nature fails to remove an obstruction and simple measures—such as distention of the canal anterior to the obstruction—fail, an effort should be made to grasp the body by means of long, very narrow dressing forceps

Fig. 212.—Beck's operation for hypospadias. The urethra freed.

designed for the purpose. Occasionally small substances may be removed by means of a small curet with a long handle. If these measures do not accomplish the desired results, an incision should be made over the shaft of the organ and the obstruction removed; this is not a very serious operation. Or, if desired, the ordinary perineal incision may be made and the substance pushed back through the perineal wound.

HYPOSPADIAS

Hypospadias, or fissure of the inferior urethra, is ordinarily a congenital condition, and is generally divided for purposes of description into three classes, of which the first is the most common: (1) Hypospadias of the

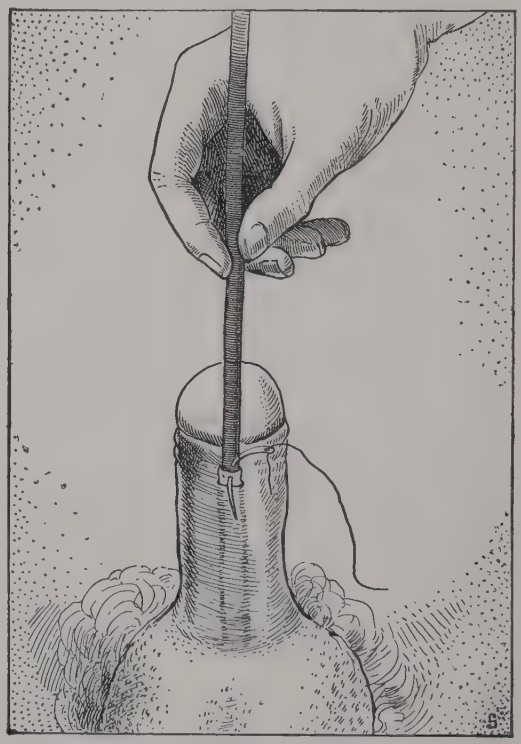


Fig. 213.—Fastening hypospadiac orifice to the catheter.

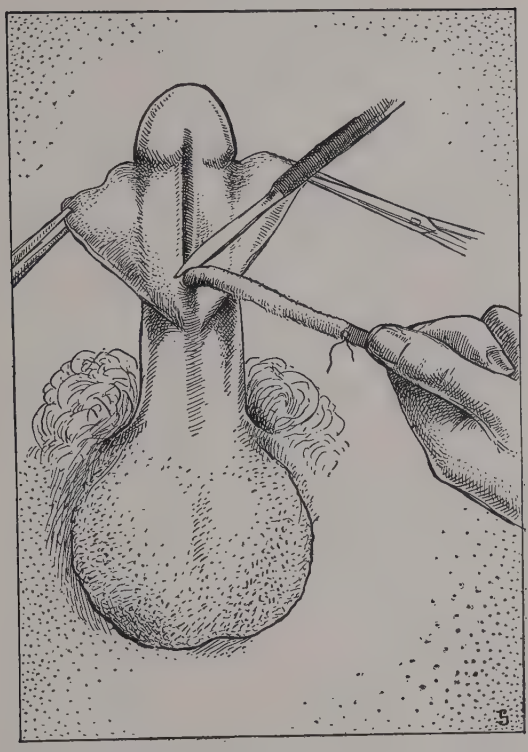


Fig. 214.—Dissecting the urethra while stretching it with catheter.

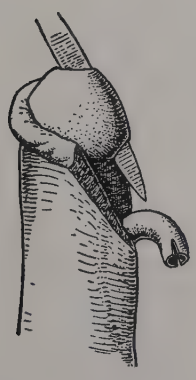


Fig. 215.—Beck's operation for hypospadias. Tunneling the glans.

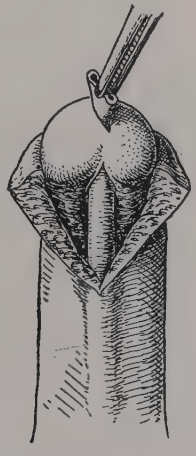


Fig. 216.—Beck's operation for hypospadias. The freed urethra brought through the tunneled canal in glans.

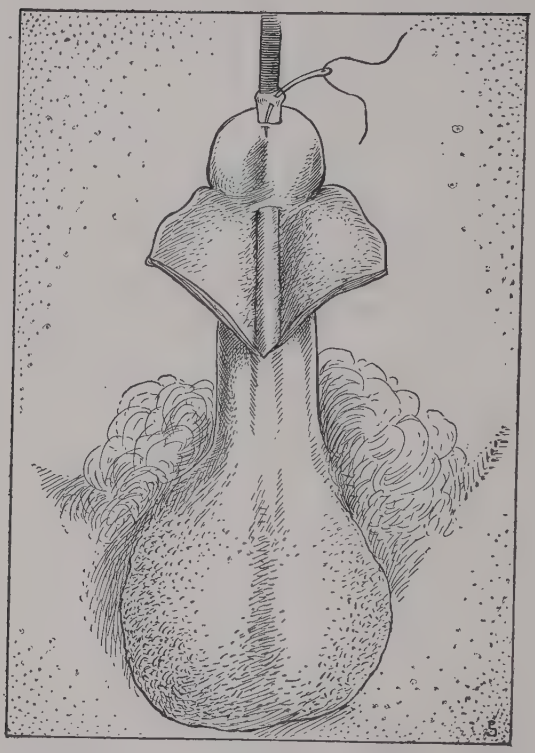


Fig. 217.—Catheter with urethra drawn through glans; insertion of suture.

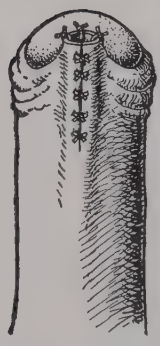


Fig. 218.—Beck's operation for hypospadias. Suturing the skin. Glans trenched instead of tunneled.

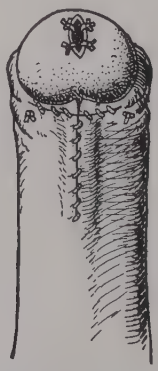


Fig. 219.—Beck's operation for hypospadias. Suture finished; urethra fastened in tunneled glans.

glans of the penis. (2) Hypospadias of the body of the penis. (3) Perineal or scrotal hypospadias.

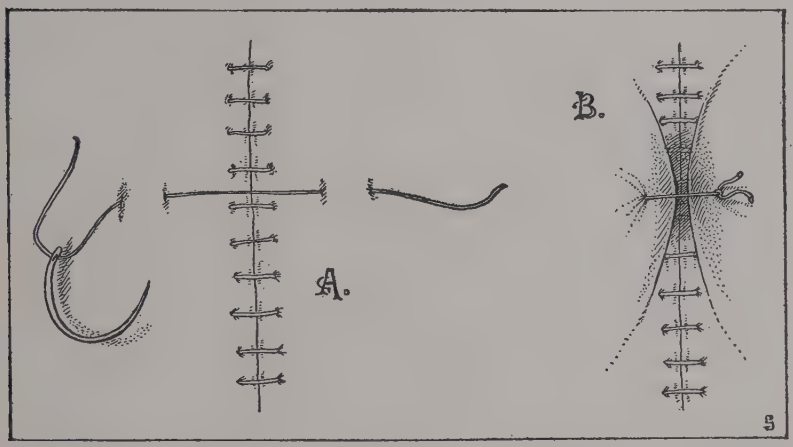


Fig. 220.—Beck's operation for hypospadias showing relaxation sutures, to allow for tension: A, Relaxation suture introduced over simple suture; B, relaxation suture complete.

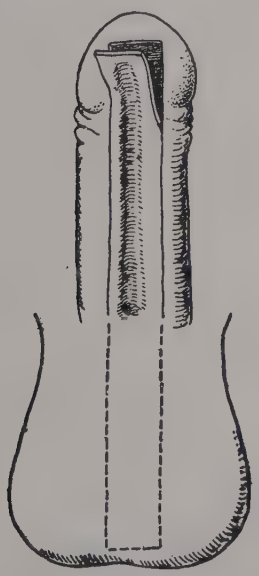


Fig. 221.—Beck's operation for scrotal hypospadias. Showing line of incisions.

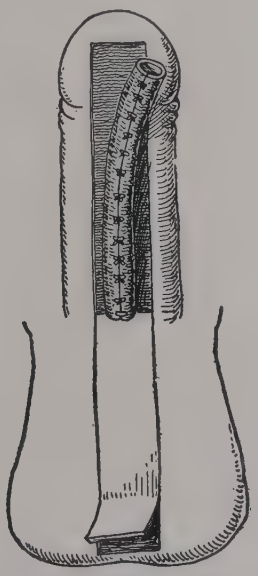


Fig. 222.—Beck's operation for scrotal hypospadias. Showing new formed urethra.

Operations for the relief of this condition are extremely interesting and deserving of more consideration than can be given them

here. When the penis is curved downward and bound to the scrotum by adhesions, it should be cut free and the lateral wound sewed longitudinally by the method of Duplay.

The operation of Dr. Carl Beck, of New York, is the one advocated by the writers for the relief of **hypospadias of the glans.** It is divided into three parts, which are well shown in the illustrations (figs. 212 to 220 inclusive).

Make a longitudinal and two lateral incisions on each side of the urethra, and dissect from the surrounding tissue for an inch or two, if desired aided by catheter in urethra. With a trocar make a hole through the top of the glans to the urethra, draw the urethra through, fasten with a few stitches, and support and keep open for a few days with a

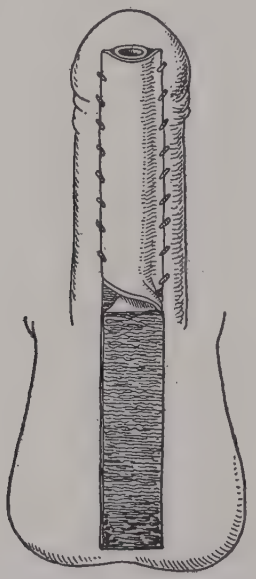


Fig. 223.—Beck's operation for scrotal hypospadias. Showing flap taken from scrotal tissue twisted on itself covering new-formed urethra.

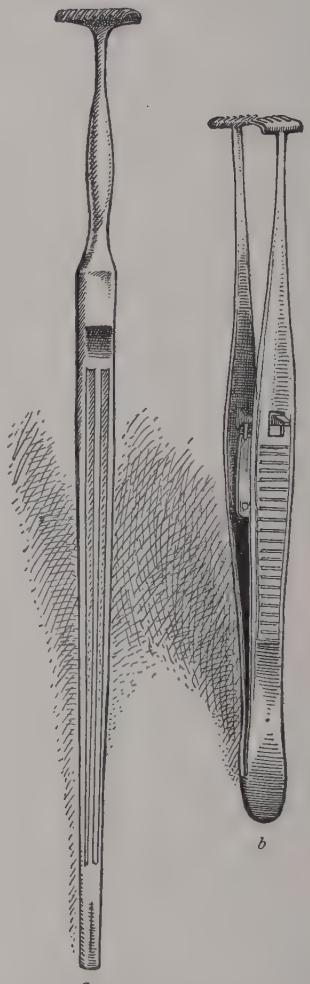


Fig. 224.—Instruments used in Beck's operation for hypospadias. *a*, Toothed retractor; *b*, toothed adjustable holding forceps.

retention catheter, thus holding it in place until it unites. Sew up the skin wounds at the base of the glans. Relaxation sutures assist to overcome tension. Instead of tunneling the glans may be trenched.

Operations for the relief of hypospadias occurring high in the shaft of the organ are of the same character as those performed for hypospadias occurring in the glans. When situated at or near the scrotal junction, they are similar to those performed for perineal hypospadias.

Operations for the Relief of Perineal or Scrotal Hypospadias.—The Beck operation is here probably the best. It consists of making several flaps figs. 221, 222, 223):

Beck makes, on each side of the gutter

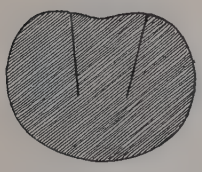


Fig. 225.—Thiersch operation for epispadias. Narrow lines for refreshing the canal in the glans. Two incisions are made which if prolonged would meet one another. First step.

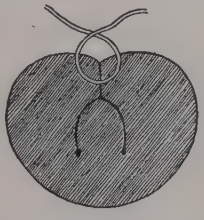


Fig. 226.—Thiersch operation for epispadias. Refreshing the canal, showing lines after the suture, the segment having been taken away and the side walls thus refreshed ligatured together over a sound. First step.

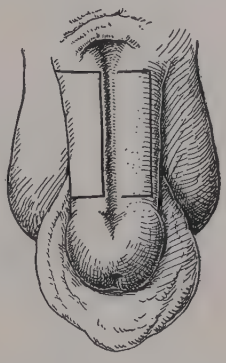


Fig. 227.—Thiersch operation for epispadias. Illustrating lines for side flaps. Second step.

and parallel to it, an incision sufficiently long to reach the point of the new urethral orifice. The penis being lifted, he unites these two incisions by a third, and forms a flap (separated from the penis by dissection) which he folds around a sound, sutures its two edges together, and thus makes a new urethra; the second flap he bends back on itself to form a surface over the new channel; this flap is cut from scrotal portion in the form of a tongue with its base superior, and is used to cover the denuded portion.

EPISPADIAS

This condition is the opposite of hypospadias—the opening being on the superior aspect of the organ. It is also an accom-

paniment of exstrophy of the bladder. The opening being high, the urethra can be dissected out, brought into proper position and replaced, and, if necessary, a small flap may be utilized to cover the open space. Epispadias in which the opening occurs at the base of the shaft of the organ is sometimes met, and is a much more difficult condition to treat. Probably the operation of Thiersch is as good as any. It demonstrates what may be and has been occasionally successfully done in the way of performing a plastic operation. First refresh and unite canal in glans (figs. 225, 226).

In fig. 227 two flaps are shown, taken from each side of the

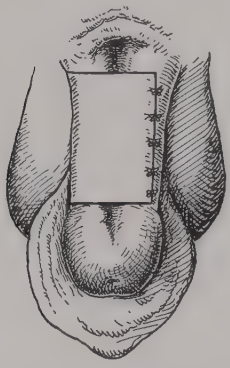


Fig. 228.—Thiersch operation for epispadias. The right flap is brought over onto the raw surface of the turned over left flap. Second step.

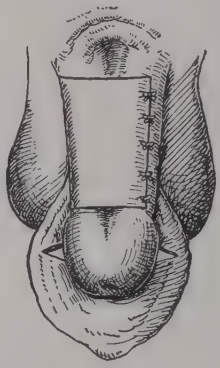


Fig. 229.—Thiersch operation for epispadias. The prepuce is incised and pulled over glans, covering freshened edges of corona fistula. Third step.

median line on the superior surface of the organ. They are so united that they come in contact, raw surface to raw surface, in the ordinary way, thus covering over the open canal with a durable roof. The next step in this interesting operation is the making of a foreskin. This Thiersch does, as is shown in the illustration (fig. 229),. by making a button-hole incision in the redundant skin hanging down like an apron underneath the glans, and pulling the glans through the opening, just as the glans penis is pulled through an opening in a piece of gauze often used as a dressing in cases of urethritis; the skin is then sutured to cover coronal fistula. The opening of the canal has now been closed over, the foreskin made and sewed in place, but the lower end of the ure-

thral opening at the base of the organ has not been closed. This the operator accomplishes, as will be seen from the cuts (figs. 230, 231), by taking two winged-shaped flaps from the pubic region, bringing them over the opening in a manner analogous

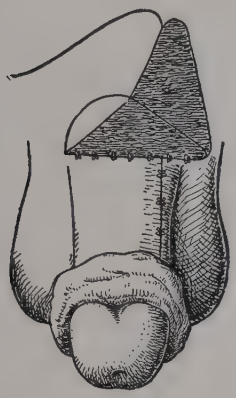


Fig. 230.—Thiersch operation for epispadias. Showing two flaps, left triangular, right rectangular; left turned over orifice and base of penis. Fourth step.

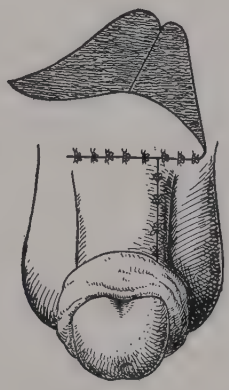


Fig. 231.—Thiersch operation for epispadias. The rectangular right flap has been brought over on to the top of left flap. Wounds caused by flap removal will close by granulation. Fourth step.

to the flap operation on the shaft of the penis, and securing them according to the method shown in the illustration.

Almost all operations for the relief of epispadias and hypospadias of any extent require a perineal section in order that the parts may be kept at rest while healing is taking place.

AMPUTATION OF THE PENIS

This operation is not infrequently performed for cancer, and may be made necessary by injury or gangrene. In the main there are two operations for the relief of cancer of the penis or allied conditions. Both are comparatively easy to perform. One consists of entire removal of the organ, and the other of the performance of amputation in continuity. The writers recommend the latter operation for cancer, as the operation of complete removal of the gland is open to serious objection.

The operation for entire removal is performed as follows: The

legs of the patient being elevated and the proper operative toilet having been made, an incision is made splitting the scrotum down to and exposing the urethra; then, with careful dissection, the corpora cavernosa are dissected away from the urethra, this canal being allowed to hang down like a piece of tape. The corpora cavernosa are now severed at their connection to the crest of the pubes; this is likely to cause severe hemorrhage, and Dr. Henry H. Morton recommends burning off the corpora cavernosa from the pubes by means of the thermocautery to avoid hemorrhage. After the corpora cavernosa have been removed, the urethra is pulled through the perineal opening and stitched to

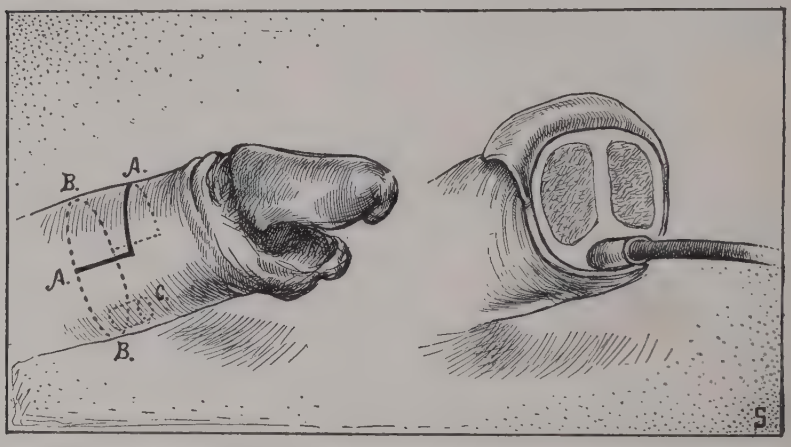


Fig. 232.—Amputation of penis: *A*, *A*, Method of making dorsal flap; *B*, *B*, line of amputation; *C*, projection of urethra.

its edges. Any part of the urethra that proves too long for the purpose required can now be snipped off. As has been observed by Dr. Morton and others, with whose observations the writers, from their limited experience, are in accord, the objections to this operation, which is a comparatively simple one to perform, and is, in its way, brilliant, are that where the cancerous process has advanced so far as to demand this procedure, death from extension of the process or from infection of the wound rapidly ensues. The operation of choice, then, for cancer of the penis is to amputate as soon as a positive diagnosis has been made.

A word as to the diagnosis between gumma and cancer of the penis. It is, in certain cases at least, impossible to differentiate from the appearance of the ulceration alone. In a case seen in the service of one of the writers at the City Hospital the absence of a syphilitic history and the clinical appearance of the ulceration seemed to point conclusively to cancer. A section examined microscopically failed to show the presence of cancerous tissue. The pathologist, however, was convinced, from the appearance of the lesion, that the specimen was cancerous, although, as said, microscopic examination failed to prove this. An active course of antisyphilitic treatment was instituted, but the ulceration continued to spread. Contrary to the judgment of the house staff, and in spite of the increasing ulceration, operation was postponed, and the antisyphilitic treatment was continued. At the end of about a month, when it seemed utterly injudicious to delay longer, operation was decided on. Before the day of operation arrived, however, the ulceration had begun to improve under the same treatment that it had so long withstood. Healing continued with astonishing rapidity, and in a period of about two weeks complete recovery ensued. Although there was no evidence to substantiate this view, it is possible that the method of administration of the antisyphilitic treatment in this case was faulty. Since this time it is the writers' practice, despite the clinical appearance and the history of the case, to advise against amputation of the penis for the relief of cancer until thorough antisyphilitic treatment has been carried out for several weeks, in order that an absolute diagnosis may be arrived at before operating.

Amputation of the penis in continuity is a simple operation to perform, and, under ordinary circumstances, gives good results. It is performed as follows: Run any sharp, pointed instrument through the body of the penis—hat-pins have been popular in the past. It is not necessary, as was formerly done, to run two instruments through, nor is this done, as was stated by some of the earlier writers, for the purpose of preventing the urethra from slipping back. The pin is run through merely to serve as a point of anchorage for the ligature. Pass a small soft-rubber catheter around the penis, and under and over the projecting ends of the

instrument that has been run transversely through the body of the organ, tying it tightly or compressing it with forceps in order to prevent hemorrhage. Mark the point at which it is desired to amputate; then make another mark on the body of the penis, an inch or so in advance of the first mark on the superior aspect, which is the point for making the preliminary incision. This incision should go only through the skin, and is made for the purpose of procuring a flap for the corpora cavernosa. Dissect the skin back until the mark on the superior surface of the organ is reached—the point at which the actual amputation is to be done. Next cut through the corpora cavernosa down to,

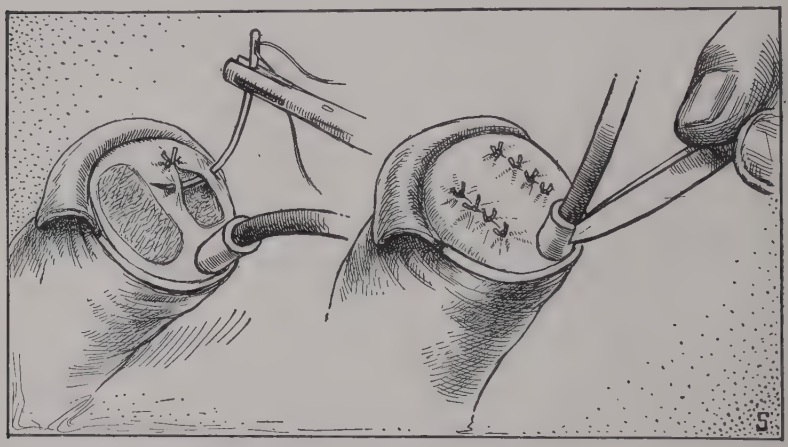


Fig. 233.—Amputation of penis. Method of sewing together the sheath of the corpora cavernosa and the splitting of the urethra.

but not through, the urethra. This will leave the urethra protruding, with the glans of the penis hanging to the end of the urethra. It will then be seen that each of the corpora cavernosa is surrounded with a sheath. With fine ligatures sew the sheath of each over the end of the respective corpus to prevent hemorrhage. Before this is done tie off any bleeding points that may be left. After the sheaths have been carefully stitched over the corpora, attend to any further hemorrhage that may exist. Then cut off the glans from the end of the urethra, leaving the urethra protruding about a half-inch from the wound, like the nozzle of a spout; split the urethra at the bottom, take one stitch through

the corner angle of the urethra, and run it up through the corresponding flap; take the next stitch through the other corner of the urethra, and run it through its corresponding flap; place a few sutures in between, and two or three below. It is a matter of little importance, apparently, if these sutures are not placed precisely in the proper manner and if the urethra should have a slight twist at the point of the amputation. Remove the hat-pin or other instrument that was first used, and also the ligature. Pass a large sound a short distance so as to be certain that the urethral opening is large enough; introduce a catheter à demure,

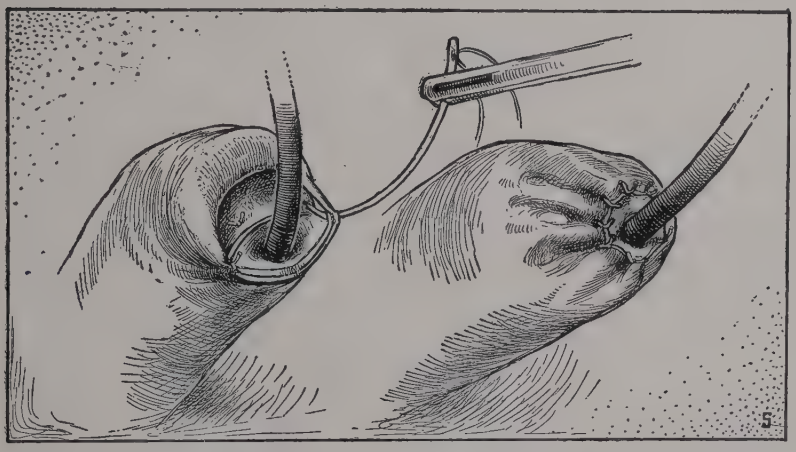


Fig. 234.—Amputation of the penis. Stitching the urethra to dorsal flap and final appearance of stump.

and apply a suitable dressing to the wound. Pay particular attention to the dressing of the wound for the first three or four days after the operation, at the end of which time the catheter may be removed, or it may be allowed to remain for a few days longer. After the catheter has been removed, under ordinary circumstances, a good stump will have been obtained, and the patient will be able to urinate with a comparative degree of comfort. In performing this operation, some surgeons are accustomed to remove, at the same time, some of the glands from the groin. This seems to the writers a useless procedure unless these nodes are known to be involved. The illustrations (figs. 232, 233, 234) show this operation in detail. They are made from

sketches made while one of the writers was amputating for relief of a phagedenic chancroid.

PHIMOSIS

Phimosis is a condition in which it is impossible to retract the foreskin back of the glans, because of adhesions or inflammatory processes. This condition is familiar to most practitioners. It occurs most frequently as the result of urethritis or of uncleanliness; in the latter case the smegma which has been allowed to collect between the inner surface of the foreskin and the corona of the glans becomes infected, and may give rise to a discharge that simulates urethritis, although urethritis may not be present. This latter condition is commonly known as balanitis præputialis. It may be differentiated from true urethritis by inserting the nozzle of a small syringe under the foreskin, between it and the glans, washing out carefully, and then, by examining the meatus closely, observing whether or not any discharge issues from its orifice. Balanitis may exist alone, but is frequently associated with urethritis. Another common cause of this condition is chancre or chancroid. Phimosis may exist for a considerable length of time, and, if there is no other active process going on, is comparatively harmless.

The treatment for the relief of this condition consists of frequent injections of a simple lotion, such as lead and opium wash, between the inner surface of the foreskin and the glans; this solution may also be applied by means of a cotton swab wound on the end of a small stick. Absolute cleanliness should be observed, the discharge and decomposing smegma being removed two or three times a day.

Operative procedures for the relief of this condition may be instituted at any time, but unless there are urgent indications, as when chancroid is present, it may be postponed so long as an acute process is going on. If the phimosis is due to syphilis, mercurial plasters may be strapped over the foreskin, mercurial washes may be used locally, and constitutional antisyphilitic treatment instituted; these measures, by causing absorption of the chancre, will in time permit the foreskin to be retracted. If operative treatment is decided upon, this is best carried out

under cocain or general anesthesia: By means of strong scissors make a longitudinal incision down the foreskin on each side of the penis, as far as the corona of the glans. This will make a lid of the upper part of the foreskin, which may be lifted up and then cut across transversely. This effects a partial circumcision. Another lid will be left by this operation at the lower surface of the penis. This lid may be removed at the time, or, better, amputated a week or two later.

After phimosis has once been relieved, as it ordinarily can be, by the use of cleansing lotions, the patient should be told that one

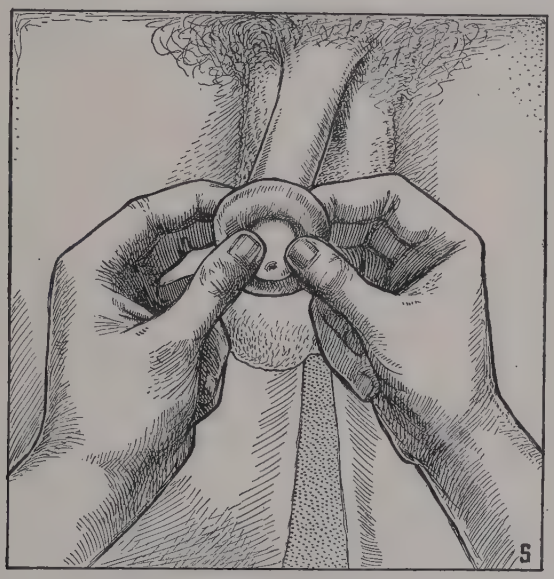


Fig. 235.—Method of reducing paraphimosis.

attack is likely to predispose to another, and that after any acute process that may be present has been cured, circumcision should be performed. If this is refused, he should be instructed to observe great care to prevent, by daily washing, the accumulation of secretions between the foreskin and the glans.

PARAPHIMOSIS

Paraphimosis is a condition just opposed to phimosis. It is the result of a tight foreskin having been pulled back of the glans,

some inflammatory condition producing a contraction that makes it impossible to bring it forward by means of ordinary measures. Edema and temporary deformity of the organ are generally associated with the condition, and tend to make it appear more serious than it really is.

Treatment.—Marked edema may be relieved by making multiple punctures with a needle, squeezing out the serum, and applying hot cloths. By holding the glans of the penis between the first two fingers of each hand and placing the thumb of each hand over the meatus, an attempt may be made, by making gentle traction with the fingers, to push back the glans underneath the foreskin. The procedure is generally successful. If the condition is allowed to go untreated, ulceration of the constricting band may take place. If gentle measures fail, an incision one or two inches long may be made over, down, and through the constricting band, which can be felt just back of the corona.

CIRCUMCISION

The removal of an excessively long foreskin as a hygienic measure is one of the oldest operations known to surgery. There are several methods of performing circumcision, the choice of these depending on the demands of the individual case. For an acute phimosis associated with chancroid, circumcision by means of lateral incisions made on each side of the foreskin, as described previously for the relief of phimosis, is the operation of choice. The best method for performing circumcision in children and infants is to make a straight incision in the median line on the superior aspect of the penis through the foreskin as far as the corona, one being also made through the membrane to the same extent. Retract the mucous membrane and the skin, and with the thumb break down any adhesions, being sure that the corona of the glans is entirely free. Insert one suture in each upper corner of the incision, in order to hasten the adhesion of the skin and the mucous membrane. A little, if desired, may be clipped off each corner before the stitch is inserted. Dress the wound with a wet dressing, such as lead and opium wash, keeping compresses soaked in this solution over the wound for several days. This

method of operating consumes but a few minutes, and is by far the one of choice with children. The tabs or ears that, in the adult, tend to form underneath when this method of circumcision is performed, become, in time, absorbed in the child. In tuberculous children or in those in poor general condition a severe balanitis is likely to follow this simple operation. Rest in bed and the constant application of a soothing dressing will cause this complication, in which the glans may become very much excoriated, to disappear in a few days.

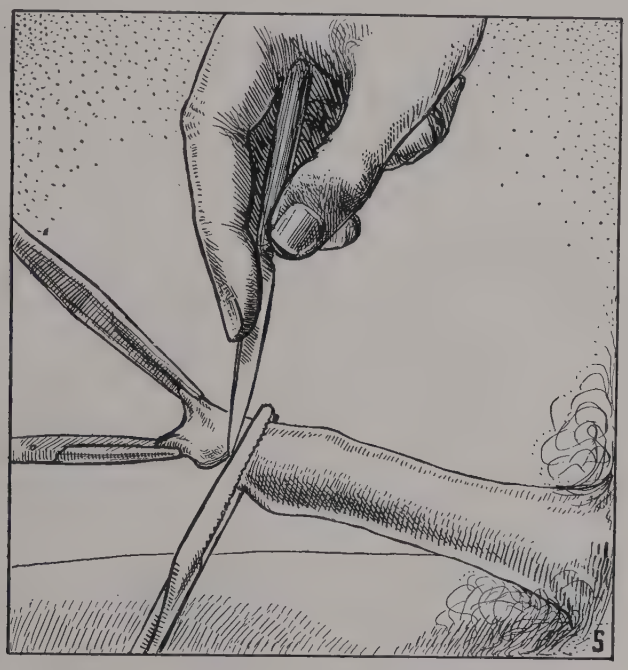


Fig. 236.—Circumcision with clamp. Removing the foreskin.

The ordinary method of performing circumcision on an adult is as follows:

An encircling mark should be made on the foreskin, parallel to the corona glandis, one-fourth of an inch in front of the margin of the corona on top, and underneath the glans toward the frenum, one-half to three-quarters of an inch above the sulcus of the corona. It is best, as a rule, to perform this operation under general anes-

thesia—if desired, nitrous oxid gas may be used for this purpose; not infrequently, however, local anesthesia is employed. In such cases cocain—2 per cent.—should be used freely. A few drops should be injected into the tissues of the foreskin in the neighborhood of the mark that was made to act as a guide for the incision. This should be followed by the application of a clamp. Many varieties of clamps have been devised for this purpose, but for one familiar with the operation, almost any large one will answer. The foreskin having been pulled over the glans

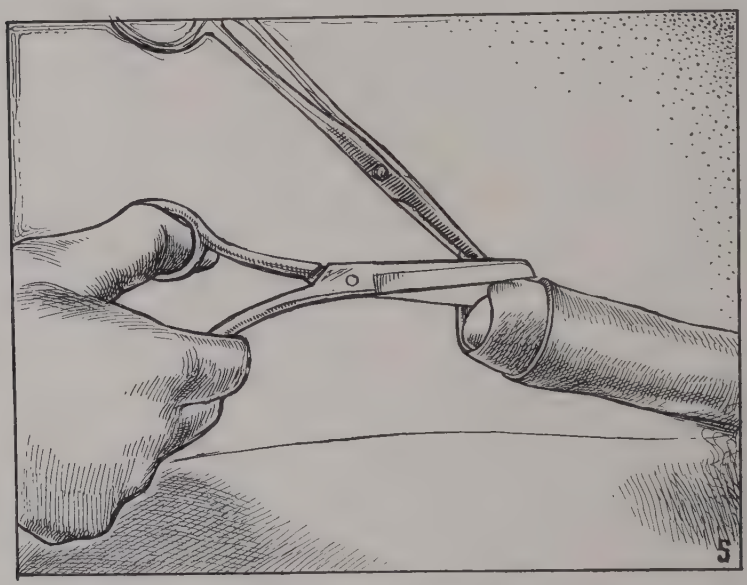


Fig. 237.—Circumcision with clamp. Splitting of the membrane.

and clamped, at the indicated place, by a quick stroke of a very sharp knife, the foreskin should be severed, the clamp removed, and any bleeding points caught up with artery forceps. The mucous membrane then presents itself for removal; this is generally the most painful part of the operation. A small quantity of cocain solution should be injected into several portions of the mucous membrane, and then, with a pair of sharp scissors, it should be incised on its superior border down to within a quarter of an inch of the severed skin; next, with the scissors, cut off the

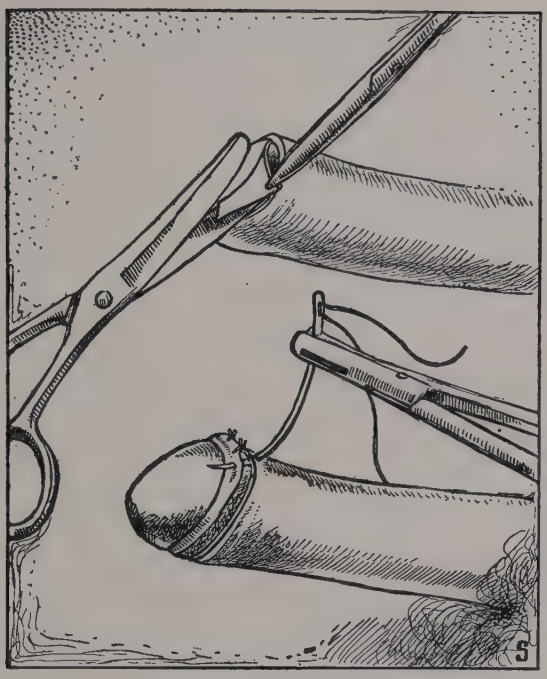


Fig. 238.—Circumcision with clamp. Trimming the membrane and sewing membrane and skin together.

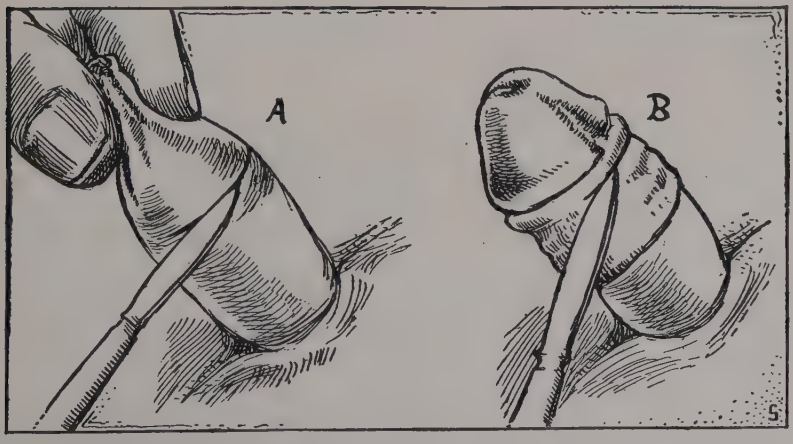


Fig. 239.—Showing method of performing circumcision without a clamp: *A*, Incision in the skin; *B*, skin turned back like a cuff and membrane incised.

corners of the membrane, running along parallel to the cut surface of the skin and ending at the frenum in front. The skin and mucous membrane should be sutured together, a sufficient number of fine catgut ligatures being employed. It is better to insert

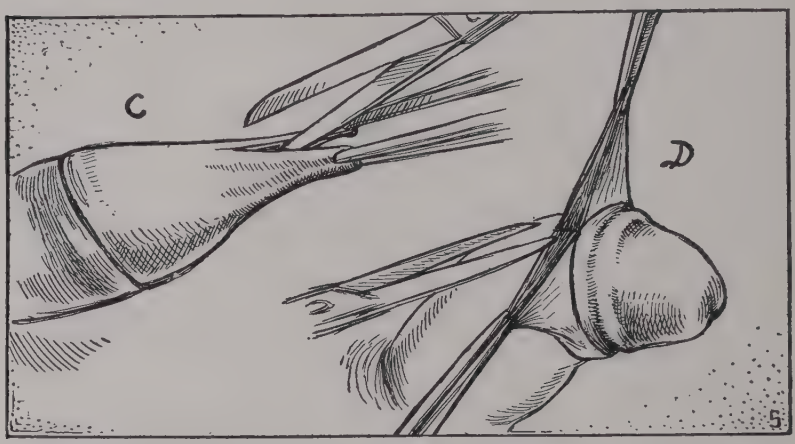


Fig. 240.—Showing method of performing circumcision without a clamp: *C*, Skin pulled forward and incised on superior aspect to meet other incisions; *D*, skin and membrane dissected off.

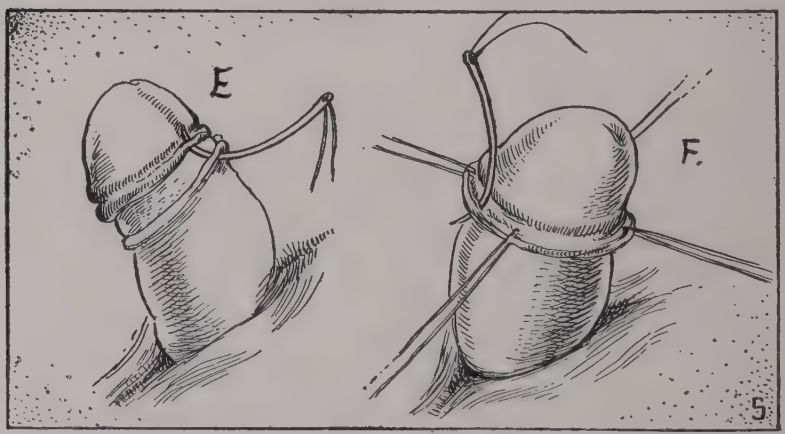


Fig. 241.—Circumcision without a clamp: *E*, Appearance after dissection of skin and membrane; *F*, insertion of stitches.

too many sutures than too few. The penis should next be carefully cleansed and the sutured surfaces dusted with iodoformogen. A narrow strip of gauze bandage should be wrapped about the

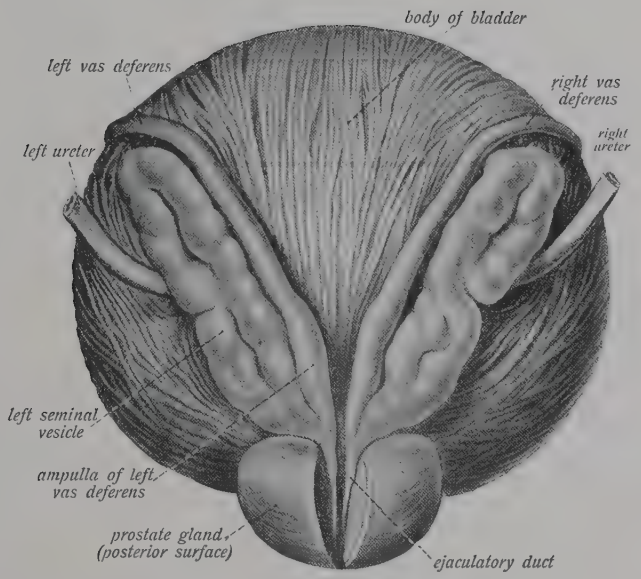
wound at the site of the suture. This should be covered with a strip of zinc oxid plaster of the same width. The elaborate bandaging occasionally employed is unnecessary. The patient should be instructed to hold a small pad of gauze immediately under the meatus when he urinates, so that no urine will enter the wound. After the operation the patient should be put to bed, and, if cocain has been used, he should be told that within two hours he will probably feel worse than he did immediately after the operation. The longer the patient can be kept quiet, the better, as the irritation produced by walking tends to retard healing. The bandage should be changed frequently and great cleanliness observed. Under proper antiseptic precautions, serious complications rarely, if ever, follow this operation. The tendency in performing circumcision is to remove too much rather than too little of the foreskin. If too much is removed, quite a long period of time will be required for the necessary granulation to take place. Our illustrations (figs. 236, 237, 238) show the ordinary procedure clearly. Another method, and a good one, is shown in the illustrations made from sketches (figs. 239, 240, 241), by which the foreskin may be removed by the aid of a clamp.

CHAPTER XXV

THE SEMINAL VESICLES

At the base and on each side of the bladder are found tubular sacs that unite with the corresponding vas deferens just at the ampulla. They are lined with a mucous membrane of columnar epithelium, resting on an areolar connective-tissue basement membrane. Outside of this layer is a smooth muscular coat that is united by strands of connective tissue to an external fibrosa. The seminal vesicles secrete a fluid that mingles with spermatozoa, forming the seminal fluid; they may also serve as reservoirs for the storage of semen just prior to ejaculation.

Diseases of the Seminal Vesicles.—The diseases of the seminal vesicles have of late years received a considerable amount of attention from specialists. Undoubtedly there is pathologic evidence to support the views of many who have written concerning the diseased conditions of the seminal vesicles. The most frequent form of seminal vesiculitis is due to an extension of a gonorrheal process from the posterior urethra. The vesicles may also be involved in tuberculous processes, or may be the seat of invasion of malignant growths. The inflammatory condition may be of a catarrhal nature, or, more rarely, abscesses of considerable size are seen. Clinically, from the writers' experience, diseases of the seminal vesicles are, nevertheless, of comparatively rare occurrence. Several years ago the writers studied a series of 116 cases of urethritis, in every one of which the prostate and the region of the vesicles were examined carefully through the rectum; in thirty the secretions obtained by means of prostatic massage, were examined microscopically by an expert pathologist. In not one of these cases was there any evidence pointing toward an involvement of the seminal vesicles. As to the question of



The urinary bladder with the seminal vesicles, the ampulla of the vasa deferentia, and the prostate seen from behind and below. The prostate is partly divided longitudinally (Sobotta and McMurrich).

involvement of the seminal vesicles in tuberculosis, it is interesting to observe the frequency with which tuberculous testicles having a thickened and indurated cord are removed. In other words, there is a route leading directly to the vesicles, but there is rarely evidence of vesicular involvement after the testicle is removed. From a clinical standpoint, the vesicle would thus appear to be an organ that, while open to infection, is only exceptionally involved in inflammatory conditions that so frequently attack neighboring structures.

Vesiculitis is commonly differentiated from chronic posterior urethritis and chronic inflammatory conditions of the prostate by the finding, by means of careful rectal examination, of a small swelling, of the shape of the tip of a glove-finger, just above the prostate, on each side of the median line. If the swelling is slight and situated quite high up, and if the individual to be examined is inclined to be corpulent, a long finger may be required in order properly to reach the mass. As an aid to the diagnosis, the finding of pus and spermatozoa in the secretion massaged from the region of the vesicle by a finger in the rectum is useful.

The clinical symptoms of a catarrhal vesiculitis of a chronic form resemble very closely those of a chronic posterior urethritis or prostatitis; an acute seminal vesiculitis or presence of a large abscess so closely resembles an acute prostatitis or a prostatic abscess that they can be distinguished only with difficulty.

The *treatment* of vesiculitis is very similar to that of diseased conditions of the prostate, with which it is so closely allied. Irrigations of the bladder, measures tending to improve the general tone of the patient, and, in cases where it is indicated, massage of the prostate and of the vesicles are useful. When large abscesses form that do not break into the posterior urethra and the contents of which cannot be expelled by massage, operative measures may, in certain cases, be required. The writers would hardly go so far, however, at the present time at least, as to advise the performance of an incision through the perineum and opening and drainage of the vesicles for the relief of such a condition as gonorrheal rheumatism, unless a well-marked, definite abscess could be made out; in the latter case it is subject to the same surgical laws as govern the treatment of an abscess occurring

in any other portion of the body, modified by knowledge of the function and the position of the vesicles. If an operation for the release of pus in this location is followed by relief from pain involving various other portions of the body, it is what is naturally

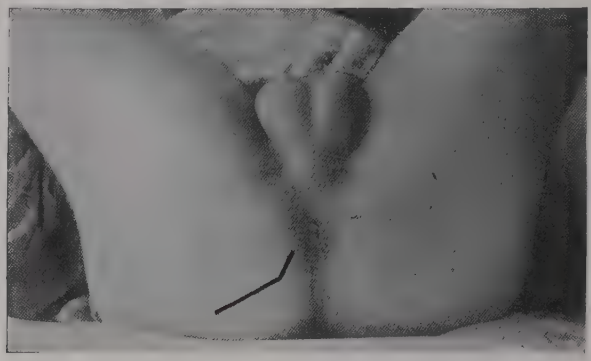


Fig. 242.—Kraske's incision.

to be expected to follow the opening of an abscess and the release of pus as in other portions of the body.

There are several incisions that may be used for the purpose of opening or for effecting removal of the seminal vesicles. These incisions are described in detail here, as they will be found useful

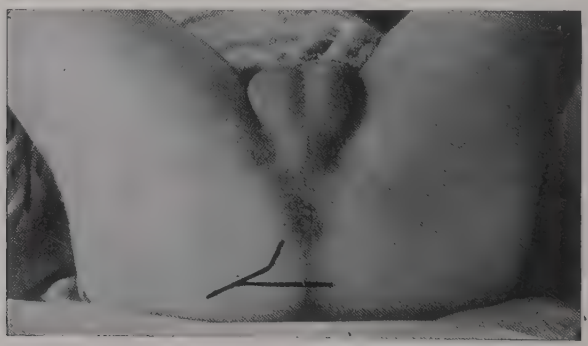


Fig. 243.—Rydygier's modification of Kraske's incision.

not only for opening an abscess in, or for the removal of, a seminal vesicle, but also for opening an abscess in the prostate, for general diagnostic purposes where it is desired to explore the perirectal tissue, and for the relief of stricture in performing external ure-

throtomy without a guide. It is to be remembered, however,

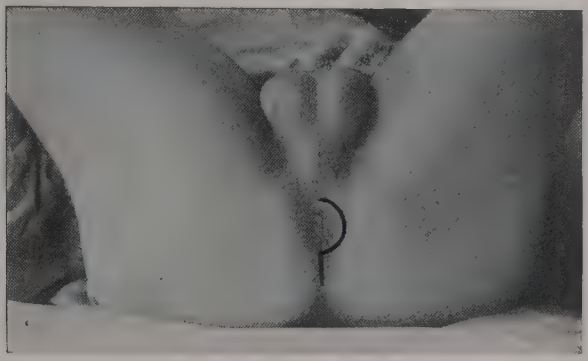


Fig. 244.—Van Dittel's incision.

Fig. 245.—Kocher's incision.

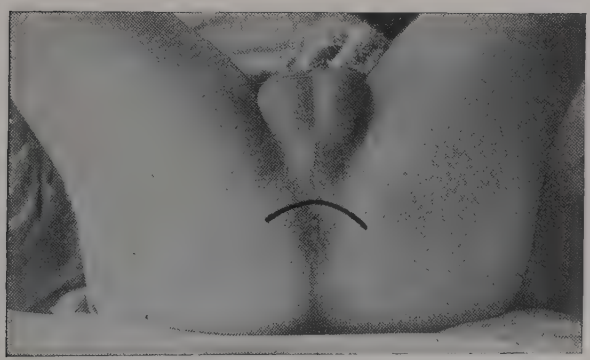


Fig. 246.—Zuckerkandl's incision.

that the writers do not advocate their use ordinarily for the

removal of an enlarged prostate, preferring other routes. The

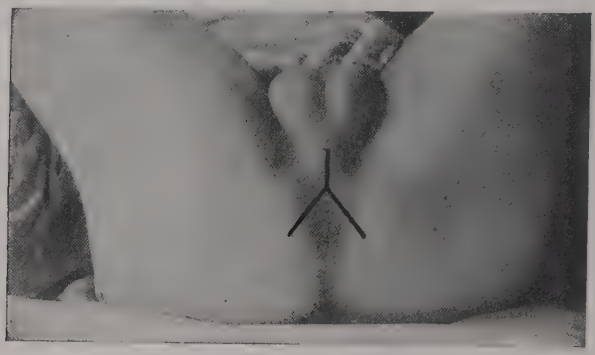


Fig. 247.—Senn's incision, No. 1.

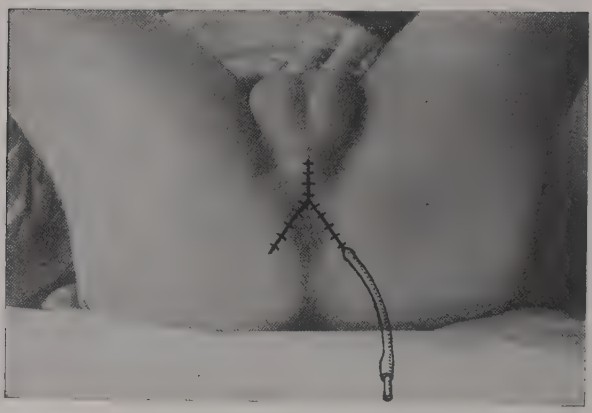


Fig. 248.—Senn's incision, No. 2.

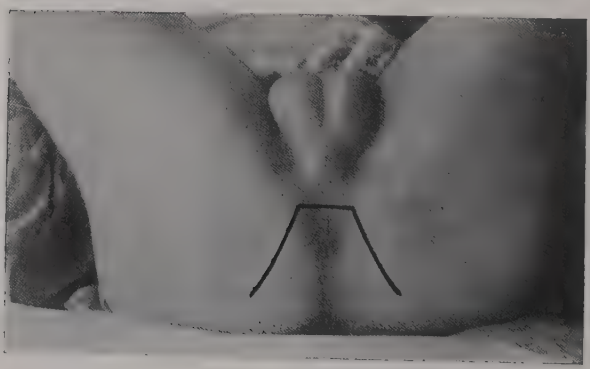


Fig. 249.—Fuller's incision.

number of incisions that have been named for their originators

is so large that it would be very difficult, if not impossible, to decide which one was best suited for the purpose. The Kraske, the Rydygier, and the Van Dittel, being one-sided incisions, are perhaps more useful to the rectal surgeon. The Zuckerkandl and the Kocher are so similar that they should be considered together. The Senn and the Fuller differ somewhat from the other incisions mentioned and from each other.

In the Senn operation "a median perineal incision is made, as

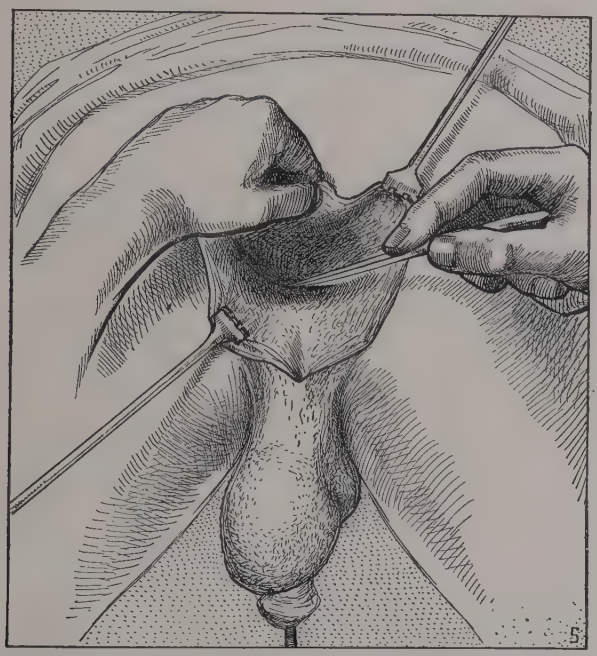


Fig. 250.—Opening periprostatic space; showing curved line of cleavage between the urethra and the rectum; recto-urethral muscle and triangular ligament just being incised. Sketched at operation.

in an external urethrotomy, and the urethra is laid bare, but not opened; from the lower angle of the median incision on each side lateral incisions are then carried to a point half-way between the anal margin and the tuberosity of the ischium, and, chiefly by means of blunt instruments, the rectum is dissected out of the way. This is a comparatively bloodless operation, and there is not much danger of wounding the rectum. The wound is opened as extensively as possible with deep retractors, and, if

considered necessary, an incision is made in the urethra and a finger introduced through it into the bladder, acting like a blunt hook, will help to push the prostate and vesicles up into a position within reach of the operators."

In the operation devised by Dr. Eugene Fuller, of New York, the incision, as will be seen from the cut (fig. 249), begins considerably further back than where the Senn incisions terminate. "From a point a little above the upper border of the coccyx, and just inside the

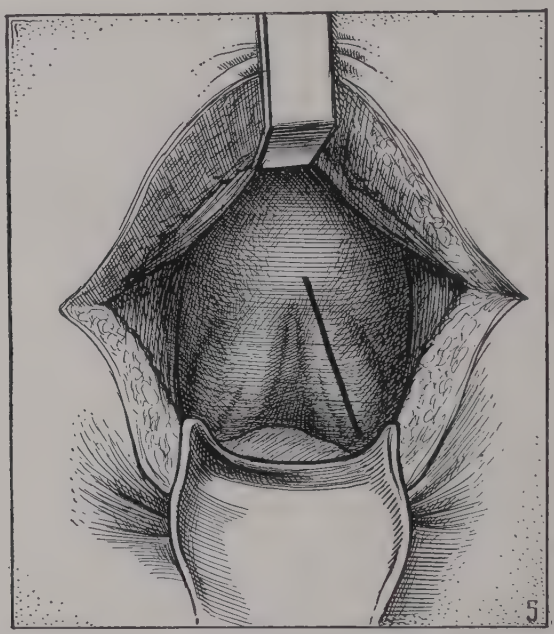


Fig. 251.—Removal of seminal vesicle through a perineal incision. At the apex of the exposed field under the retractor is situated the membranous urethra, below it lies the prostate, and below the prostate the seminal vesicles. Hugging the rectum, the capsule is incised. The incision is made over the entire length of the vesicle up to the prostate (Pierre Duval).

body of the right ischium, two converging longitudinal cuts are made which extend downward and slightly inward, keeping just within the borders of that bone, passing the tuber ischii, and ending a short distance below the tuberosity at a point laterally, and about three-fourths of an inch anteriorly, to the anterior margin of the anus; the incision on the left and that on the right correspond exactly to each other. The transverse incision is then made, which connects the converging ends, dividing the perineum trans-

versely about three-fourths of an inch anterior to the anterior margin of the anus; then the longitudinal incisions and after this the transverse one are deepened, being careful to keep far enough away from the anus to avoid wounding the sphincter muscle. With the thumb and finger of the left hand, in the rectum and out, the flap containing the rectum is then pulled up out of the way, the cutting being done with the right hand, the fingers in the rectum serving as a guide; the object is to incise along the

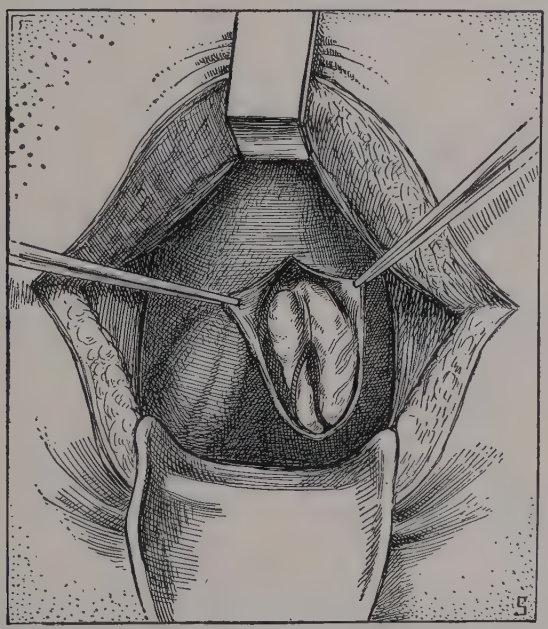


Fig. 252.—Removal of seminal vesicles. The capsule is opened. Exposure of the vesicle. The vesicle is seen to the right, the vas deferens with its ampulla to the left, on the external border of which is the group of vessels (Pierre Duval).

rectal walls as closely as possible without wounding them. Blunt dissection will enlarge the incision sufficiently to permit the prostate or vesicles to be attacked. A plentiful number of sutures should be introduced, a space for gauze packing being left in the middle of the transverse cut."

It should be borne in mind that a very large abscess in close proximity to the urethra has a tendency to bulge toward the perineum. This being the case, almost any semilunar incision will suffice for drainage.

The various incisions into, as well as the anatomy of, the perineum have been recently exhaustively considered in one of the best works on the prostate yet written, "Enlargement of the Prostate, its Diagnosis and Treatment," by John B. Deaver, Philadelphia, 1905.

A word of our own concerning the incision, anatomy of the perineorectal region, and appearance of the space between the rectum, bladder, and prostate: If as an aid in performing prostatectomy by means of some form of prostatic depressor the prostate is pulled down, a straight or some other form of incision may answer that purpose; but if it is desired to open up the space mentioned, only one form of incision can be used after the skin and superficial muscles have been incised, and that is well shown in our illustration (fig. 250), the dark crescentic line to the left of the knife representing the natural line of cleavage between the rectum and urethra. This illustration is made from a sketch drawn while one of us was recently operating for a prostatic abscess. The line, it will be noticed, resembles closely the Zuckerkandl incision. Incising at the point shown in any other direction would wound either the urethra or rectum or strike bone. It is difficult, in operating to open up this space, to get the picture as shown in anatomies. It is well to remember that the muscles to be cut through seem to be bunched, the thickest at the bulb. After they have been incised the space opens up. In performing the operation it is well to hug the rectal wall very closely, follow-

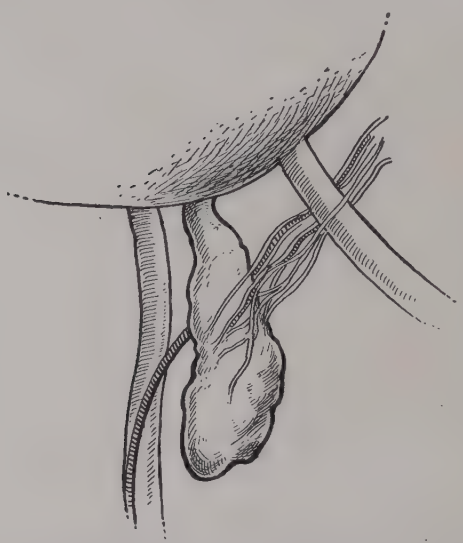


Fig. 253.—Scheme of vascular pedicle of vas deferens and the seminal vesicle. To the right is the ureter, opening into the bladder. Behind the ureter lie the arteries and veins running to the external border of the vesicle, the artery of the vas lying on the front of the canal (Pierre Duval).

ing the general directions as laid down in the description of the Fuller incision. The appearance of the opened up space is as shown in the illustration made from a sketch (fig. 271, p. 576). If the seminal vesicles are to be incised,a long, narrow-bladed knife will be found convenient. We prefer, when practicable to obtain it, to have the patient in the knee-chest position. It is difficult to keep the field of operation clean, but there seems to be a tendency

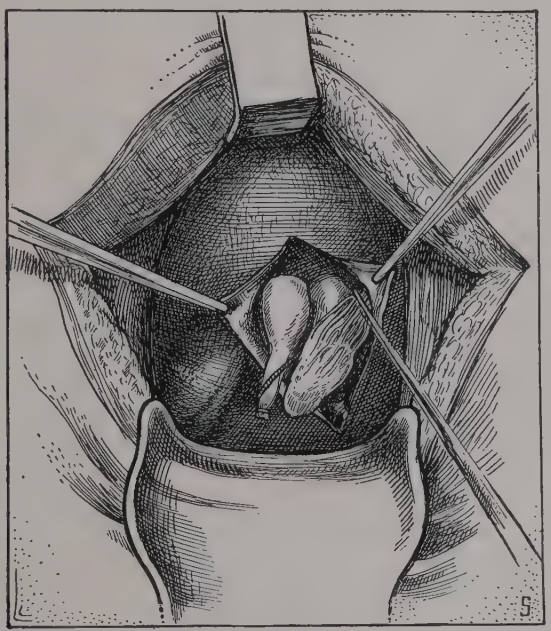


Fig. 254.—Removal of seminal vesicles. The vas deferens with its artery is ligated, cut across, and turned inward. A forceps is placed over the group of vessels. The vessels are ligated, and the vas deferens and vesicle are removed *en masse* with curved scissors. Galvanocautery applied to base (Pierre Duval).

for rapid healing following these incisions. Illustrations are also exhibited (figs. 251, 252, 253, 254) to show the method by which the vesicles may be entirely removed, an operation not often necessary.

CHAPTER XXVI

ANATOMY, PHYSIOLOGY, AND PATHOLOGY OF THE PROSTATE GLAND

ANATOMY

The prostate is a glandular and muscular organ, surrounding and enclosing the posterior urethra and situated immediately beyond the neck of the bladder. It is made up of three lobes—two lateral and one median. It measures, according to Quain, about one and one-half inches transversely, one and one-fourth inches vertically, and three-fourths of an inch longitudinally. Its size, however, varies greatly in different individuals, and under both physiologic and pathologic conditions. It completely invests the prostatic urethra, in the floor of which is found the *sinus pocularis*. Just posterior to this is an erectile mass of tissue, the *caput gallinaginis*. The prostate is invested by a dense connective-tissue capsule that is closely united to the supporting structure or interstitium of the gland. The parenchymatous tissue is made up of a large number of simple and compound tubular glands, which empty through fourteen or fifteen ducts, arranged equally on each side of the median ridge of the posterior urethra. The supporting stroma of the organ is composed of connective tissue in which are found abundant masses of smooth muscle, which render the organ contractile. The glandular acini are lined by simple, sometimes stratified, columnar epithelial cells, which produce a mucoid secretion. Corpora amylacea are frequently found in these acini under physiologic conditions, but are present in greater number in many pathologic states, particularly such as cause retention of secretion.

Embryologically, the organ develops from structures analogous to those from which the uterus of the female develops, and the organ is sometimes known as the uterus masculinus. This fetal relationship to the uterus is further exemplified by the glandular and muscular arrangement of the prostate, and also,

to a certain extent, by its physiologic activities and pathologic manifestations.

The vascular supply of the gland is derived from the vesical, hemorrhoidal, and pudic arteries. The veins connect with those of the penis anteriorly, and posteriorly with the ramifications of the internal iliac vein. The nerves are derived from the hypogastric plexus, and are made up of both medullated and non-medullated fibers.

PHYSIOLOGY

The prostate secretes a tenacious and slightly turbid mucoid fluid, which is discharged into the urethra, where it mingles with the spermatozoa and other secretions of the male genital glands. Its addition increases the viability and activity of the spermatozoa, and it unquestionably forms an essential element of the male genital secretion. There is evidence suggesting the possibility of the prostate being the point of origin of an important internal secretion, but as yet nothing definite can be said in this regard.

The organ develops rapidly in size at the time of puberty, and in old age ordinarily undergoes more or less atrophy. Its activities are dependent to a considerable degree on those of the testicle, and castration causes atrophy in a great number of cases. Although the organ is essentially an accessory genital gland, it is also definitely associated physiologically as well as anatomically with the urinary organs, and assists materially in the function of active urination.

CONGENITAL DEFECTS

Errors in development are not frequent in the prostate gland. They occur most commonly associated with generalized anomalies of development or in cases of marked sexual aberration. Underdevelopment of the gland has usually been found present in cases of retarded sexual development; and on several occasions the writers have seen almost absolute agenesis of the gland attending absence of sexual instinct and function; in less marked cases the size and number of glandular acini is greatly diminished. As a general rule, the growth of the prostate corresponds quite closely to that of the testicles in the same individual, and in cases where this organ has been removed in early life, the prostate usually

remains undeveloped and its tissue is differentiated from the bladder-wall only by microscopic examination.

Occasionally one finds congenital variations in the posterior urethra; it may be unusually narrowed, very tortuous, and in some instances traversed by strands of connective tissue. Marked abnormalities may also exist in the verumontanum. The writers have recently seen a case in which this appendage was congenitally elongated and of such size that, when congested, the entire lumen of the urethra was occluded. Great variation in its size exists normally, and in some cases almost no traces of it are to be seen.

INJURIES OF THE PROSTATE

On account of the anatomic situation of the prostate gland, which is deeply placed between the rami of the pubes, direct traumatisms but seldom reach it. Furthermore, it is covered over by a thick layer of subcutaneous and perineal fat, so that traumatisms directly applied rarely cause injury to the gland, even though they may damage the membranous urethra. In the writers' experience falls are the most frequent cause of injury to the prostate, the patient having fallen astride certain sharp objects. Some forms of saddles, particularly the older type of cavalry saddle, gave rise to relatively common injuries to the prostate as a result of contusions. Even with the admirably constructed cavalry and cowboy saddles now in use in this country injuries occasionally result in riding unruly or frightened horses. In the early days of bicycling injuries to the prostate were not uncommon, and were usually due to blows received from the unduly prominent saddle prong employed in the earlier models of this machine.

Injuries through careless instrumentation are, unfortunately, still so common that every clinic affords numerous examples of them.

Traumatisms to the prostate gland are oftentimes of a very serious nature, because of its situation, its high vascularity, the difficulty of establishing drainage when the wound is infected, and the close relationship which it bears to the urethra; even relatively trifling injuries to the prostate may cause cellulitis, with urinary extravasation and extensive pelvic gangrene, or, as the histories of cases show, be followed later on by malignant disease.

HYPEREMIA OF THE PROSTATE

This condition usually follows excessive physiologic stimulation. It may occur, however, as the result of obstruction to the circulation, as in thrombosis of the hemorrhoidal veins, which is seen in inflammatory conditions of the rectum or in hemorrhoids, and in some cases of atrophic cirrhosis of the liver. The importance of the condition lies chiefly in the fact that, as a result of this prolonged congestion, true inflammatory lesions, perhaps with interstitial hyperplasia, may follow. There can be but little doubt that at least a few cases of prostatic hypertrophy may result from conditions of this nature; although, as will be discussed further on, the writers believe that, in by far the larger number of cases, prostatic hypertrophy is due to other and more specific causes.

Anemia of the prostate may result from generalized anemia, but it is seen physiologically in youth and in old age, where it is associated with underdevelopment or atrophy.

PROSTATITIS

Acute prostatitis may result from metastatic infection or from urethral infections extending from the urethra through the ducts and into the bodies of the prostatic follicles. The process may then become disseminated throughout the entire gland, although, as a rule, it is more or less localized—often to a single lobe or perhaps to only a few acini. Acute prostatitis may be set up also as the result of extensions of inflammatory, and particularly suppurative, processes of the surrounding ischiorectal structures. The disease may be anatomically divided into simple inflammatory and suppurative, according to the degree and type of the inflammation present. It is needless to say that by far the larger number of cases of acute prostatitis follow posterior urethritis of gonorrheal origin. There can be little doubt, however, but that a certain number of cases follow prostatic hyperemia, either from overstimulation or as the result of the use of irritant drugs or condiments. It is possible that a small number of cases also develop in the course of rheumatic and gouty dyscrasiæ.

The changes present in the prostate necessarily depend chiefly upon the origin and nature of the etiologic factor, and especially

on its location. Suppurative processes are particularly prolonged on account of the difficulty of drainage and because of more or less urinary infiltration and fermentation, which add in all cases to the exciting inflammatory agents. As a rule, urethral infection results in abscess formation of greater or less extent, depending on the number of acini infected and, to a considerable degree, on the virulence of the infecting organisms. On account of the

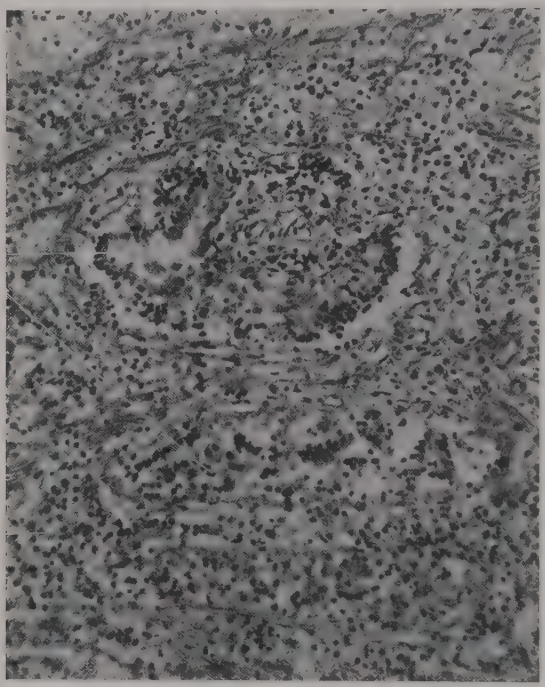


Fig. 255.—Microphotograph. Acute suppurative prostatitis following gonorrheal urethritis. *a*, Broken-down acini; *b*, purulent exudate.

dense nature of the capsule of the prostate, most abscesses drain into the urethra, which they naturally penetrate along the ducts of the diseased gland. Not infrequently, however, the pus may point and rupture into the perineal tissues or even, in certain cases, into the bladder or rectum.

When the acute prostatitis is diffuse and non-suppurative, it is more likely to become subacute or chronic and finally to result in an interstitial hyperplasia with eventual sclerosis and atrophy; or, in a certain number of cases, hypertrophy of the organ.

Chronic Prostatitis.—Chronic prostatitis is unquestionably a much more frequent disease than it is usually believed to be. Its etiologic factors may be almost exclusively grouped under the head of acute prostatitis, long continued, and of chronic hyperemic conditions due to any cause. Its anatomic changes may be classified as diffuse and localized. The former occur most often as a result of hyperemia or of acute diffuse prostatitis; the localized forms usually follow abscess formation or traumatic conditions. The pathologic anatomy of chronic diffuse prostatitis consists essentially of a diffuse hyperplasia of the connective-tissue framework of the organ, sometimes, it is true, associated with glandular hyperplasia, but, as a rule, chronic diffuse prostatitis resulting from interstitial hyperplasia causes atrophy of the glandular elements, with subsequent fibrous replacement.

Chronic localized prostatitis usually consists of long-standing suppurative processes, commonly encapsulated by dense connective-tissue formation, and ordinarily limited to a single lobe or lobule, although in a considerable number of cases diffuse necrosis or gangrene takes place, so that the entire gland may become converted into an abscess cavity, limited, perhaps, by the greatly thickened capsule.

When the chronic localized prostatitis follows healing of a suppurative process or is a result of traumatic disease, localized hyperplasia takes place, with the production of masses of scar tissue, at first highly vascular and then avascular.

HYPERTROPHY OF THE PROSTATE

Hypertrophy is by far the most important and one of the most frequent affections of the prostate gland. The condition undoubtedly occurs most commonly in old age, but the more careful examinations that are now made in genito-urinary practice tend to establish the fact that the condition is much more prevalent among middle-aged and young men than was formerly believed. Occurring in the young, the most insistent symptoms do not, as a rule, become obvious on account of the physiologic activity and possibilities of the tissues at this age. Thus, for example, although there may be some obstruction to the flow of urine, on account of the greater resiliency of the tissues, and particularly

because in youth the contractions of the bladder are more forcible, the symptoms of obstructed urination may remain for a long time unobserved. Furthermore, the writers find that in a very considerable number of senile cases a careful review of the history will serve to establish the fact that the condition has developed gradually, originating probably in comparative youth.

The chief symptoms of the disease are those resulting from ob-

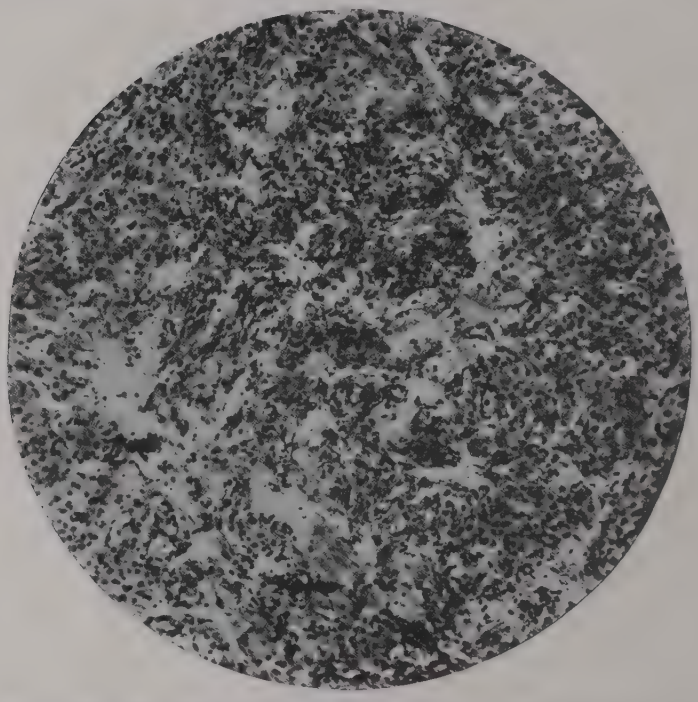


Fig. 256.—Microphotograph showing histologic changes in prostatic hypertrophy of the fibroid type. The glandular elements are completely replaced by hyperplastic connective tissue.

struction to the flow of the urine, generally associated later with infections of the prostatic tissue or of the bladder; and it is only when this urethral obstruction develops that the clinician's attention is drawn to the disease. An examination reveals the presence of an enlarged prostate. It is, therefore, to be expected that marked prostatic hypertrophy is often discovered postmortem, when, owing to the fact that the urethra was not encroached upon by the enlarging gland, no symptoms nor clinical signs were

found detailed in the history of the case. The truth of this statement has been confirmed by an extensive postmortem experience.

When the enlargement is most pronounced in the middle lobe, clinical signs develop soonest, on account of the peculiar situation of this portion of the prostate body, as a result of which enlargement causes earlier obstruction.

Before discussing minutely the etiology of prostatic hypertrophy, it seems essential, for its proper understanding, that we first acquaint ourselves with the pathologic anatomy of the condition.

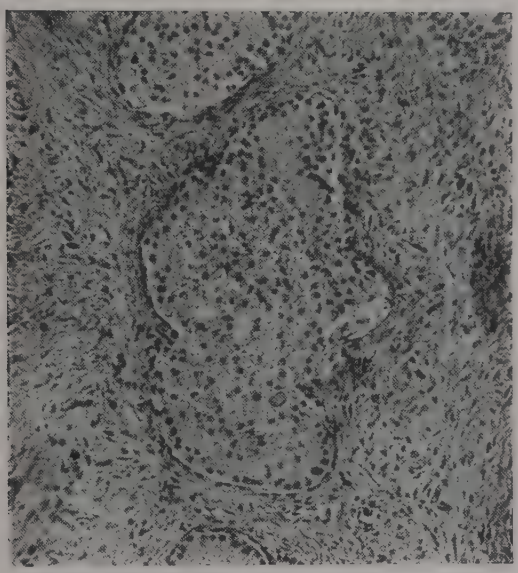


Fig. 257.—Acini in hypertrophied prostate filled by desquamated cells simulating cancer formation.

Pathology.—Prostatic hypertrophy of old age may involve the entire gland; on the other hand, the hyperplastic changes productive of the condition may be entirely or largely limited to a single lobe. As has already been intimated, the amount of disturbance that results is dependent chiefly on the degree of obstruction that exists to the posterior urethra; there also appears, however, to be an undoubted effect on the extrusor capabilities of the bladder in prostatic hypertrophy quite independent of urethral obstruction. In most cases the size of the prostate is, therefore, not of

so much clinical significance as are those effects on the function of the urethra and bladder that follow the enlargement. That this is so, has been well exemplified in numerous cases recently reported, in which great benefit followed the removal of the prostate in cases in which the enlargement was not extensive.

Almost from the first hypertrophy of the prostate was classed as a true tumor formation, and nearly all the earlier observers

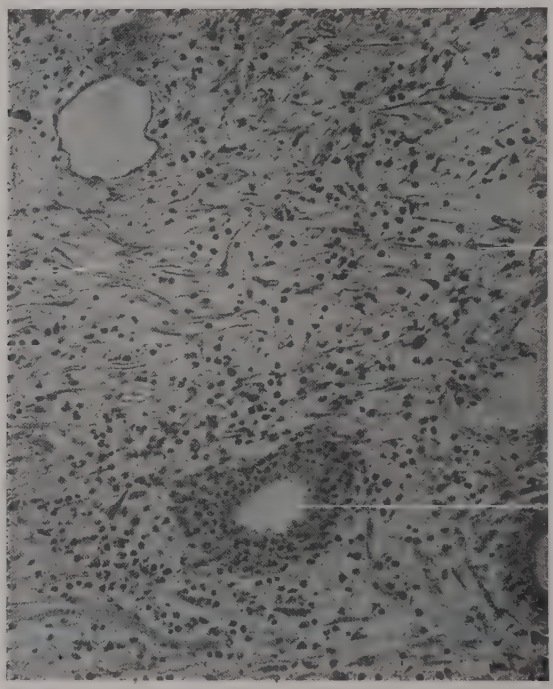


Fig. 258.—Microphotograph. Acute hyperplastic stage in hypertrophy of the prostate showing active proliferation of connective tissue in the production of fibroid hypertrophy of the prostate. *a*, Fibroblasts; *b*, acinus.

discuss the condition with this as a primary assumption. It was, however, noticed that metastases did not follow in the wake of these supposed tumors, as was the case in a considerable percentage of true tumors of similar appearance. Finally, when the use of the microscope became general and it was employed in the study of prostatic hypertrophy, it was seen that the structure of these tumor-like enlargements of the prostate was almost identical in its elements, as well as in its arrangement, with normal glandular structure. As a result of these studies the condition

now came to be considered as really of the nature of a hyperplasia and it was found possible to classify the prostatic hypertrophies, independent of their form, into those made up chiefly of fibrous tissue, those made up largely of muscle tissue, those consisting of glandular elements, and finally those in which the admixture of these elementary structures was in about the same proportion as in the normal gland. It was now generally conceded that the

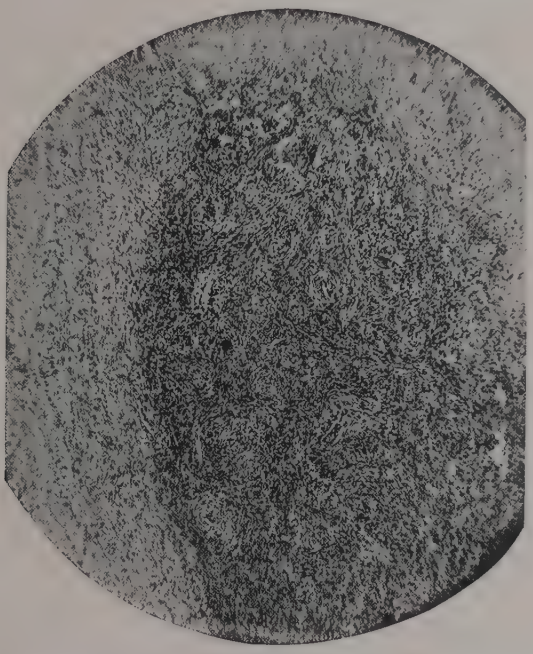


Fig. 259.—Microphotograph showing production of connective tissue in small sclerotic prostate.

process was in truth more in the nature of a fibrous, adenomatous, or muscular hyperplasia, and that the condition was not truly neoplastic in origin. Notwithstanding this plain statement of fact, there still exist many text-books—and among them excellent works on pathology—that continue to treat of prostatic hypertrophy as a tumor formation, pointing out that the development of fibroid tumors in the analogous female organ, the uterus, is of similar nature. Although the majority of the leading text-books on pathology and genito-urinary surgery have discarded this older theory, very few writers attempt to explain the manner in which this hyperplasia is excited, and why, contrary to most

other hyperplastic processes, it is reported almost exclusively in old age instead of in youth, where it might more reasonably be expected to occur.

For the purpose of determining this question the writers undertook the careful study of fifty-eight cases of prostatic hypertrophy, and published the results in an article in the Journal of the American Medical Association, April 26, 1902. Their efforts were especially directed toward ascertaining, if possible, the nature of this hyperplasia and its probable causative factors, in so far as these could be learned from the anatomic aspects of the condition. Briefly, it may be said that their conclusions have been in full accord with the results of the masterly studies made in Krakow by Ciechanowski. Very early in the work it became apparent that, as a matter of fact, there were but two types of tissue hyperplasia to be dealt with, namely, a hyperplasia of the glandular tissue and one of the connective tissue. In none of these cases were the writers able to find more muscle tissue in the hypertrophied areas than had existed in the normal tissue of the area involved; in fact, in most cases atrophy of the smooth muscle was well in evidence, and many cases had proceeded on to actual replacement of muscle by exudate or by young connective-tissue fibrils and cells. It was then found that there was a distinct difference between the true cases of myoma of the prostate gland and those of prostatic hypertrophy of old age.

In the other variety of prostatic hypertrophy, which, moreover, is the form most frequently found involving the middle lobe, the tumor is characterized by being made up mostly of glandular tissue, supported by a more or less well-defined connective-tissue stroma. It is this particular form that, on account of its close resemblance to adenoma, has largely substantiated the tumor theory of the disease. Careful analysis of sections so cut and orientated as to unite with the glandular acini of the normal portions of the prostate soon convinced the writers that this type was also to be included as merely hyperplastic and not as truly neoplastic. In short, it was found that all varieties of prostatic hypertrophy may be included under one of these heads, although the conditions are frequently associated in the same gland.

Briefly stated, then, the cause of prostatic hypertrophy must consist of factors chiefly operative during old age and that are

capable of causing growth of both epithelial and connective-tissue elements of the gland, either singly or together, and entirely distinct from the formation of true neoplasms.

Careful study of many sections from the fifty-eight cases of prostatic hypertrophy examined has fully convinced the writers that the hypertrophy is really inflammatory in origin. It was possible to demonstrate in every case either inflammatory exudation or

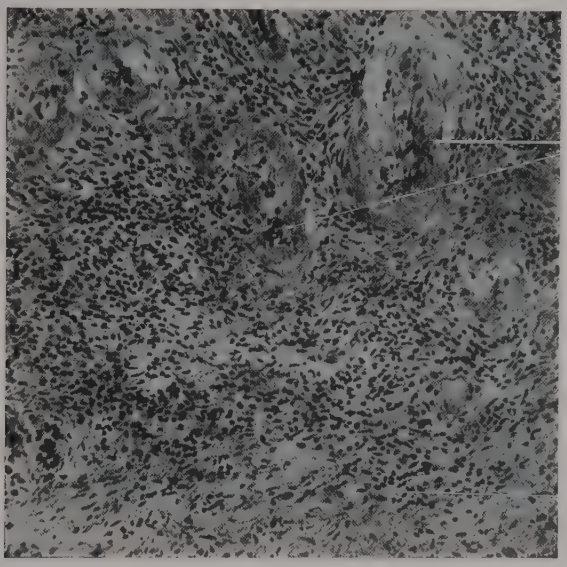


Fig. 260.—Microphotograph. Hypertrophied prostate showing atrophy of acini in the fibroid type: *a*, Atrophied and sclerosed acini ; *b*, newly formed fibrous tissue.

interstitial hyperplasia, one or both of sufficient degree fully to account for the enlargement of those glands that would previously have been classified as fibromatous or myomatous. In all these cases the formation of granulation or cicatricial tissue, just as in any chronic productive inflammatory process, is clearly demonstrable; and from the structural standpoint, no points of divergence are to be made out. It remains then but to reconcile with these findings the conditions seen in adenomatous hyperplasia, which is found not only independently, but also associated with the fibrous type just described. Careful study of the glands, where the sections are taken from the peripheral parts of these cases, shows a succession of cyst-like cavities lined with epithelial cells showing many evidences of proliferation.

As a rule, the cysts are filled by desquamated cells, generally more or less broken down, by serum and amyloid bodies, by mucus, and by other evidences of abnormal cell activity. In other words, the picture presented is that of an adenomatous growth as it might occur anywhere in the body. It is only when sections are taken from the ducts of the glands just as they are about to enter the urethra that we find the conditions that show the true nature of this interesting picture. This examination has shown, in every case of adenomatous prostatic hypertrophy, that the ducts are occluded or obstructed from the pressure of an inflammatory exudate in the more acute cases, or by hyperplastic connective tissue about the ducts in the more slowly developing cases. It is then clearly apparent that the occlusion of these ducts causes, by the retention of secretion, the cyst-like dilatations of the acini; and that the proliferation of the alveolar cells first keeps pace with the dilating saccule, and then, continuing, results in epithelial desquamation.

From this description of the pathologic anatomy of prostatic hypertrophy it is clearly evident why we have the fibrous type of enlargement so frequently associated in the same gland with the adenomatous form; for if the interstitial hyperplasia originate, or be more marked in, the peripheral parts of the gland, the result is that the acini become compressed, atrophied, and replaced by connective-tissue growth, whereas if the process originate in, or be most marked in or about, the ducts, occlusion of these passages follows and the gland saccules become converted into adenoma-like cysts. The writers' conclusions in this respect completely corroborate the anatomic findings of Ciechanowski and of other observers.

Taking for granted that this view of the pathologic anatomy of prostatic hypertrophy is correct, one can then place no other interpretation on the etiology of the condition than that it is most certainly inflammatory. Reasoning purely from the anatomic standpoint, but remembering the enormous variation and range of inflammatory processes, it must be conceded that the condition might be induced by any conditions or factors that will cause the development of an inflammatory process in any portion of the gland.

Certain of these factors have already been considered under

the heading of acute and chronic prostatitis. There is no question in the writers' mind but that inflammatory processes in the prostate, of whatever nature, might thus, as in any similar condition, bring about these hypertrophic changes; which, as in all other organs, tend to occur more often in senile than in youthful patients. In a considerable number of cases the writers were able to connect the inflammatory areas of the prostate directly with periurethral inflammation, and they again coincide with Ciechanowski in his conclusion that the most frequent cause of prostatic hypertrophy is a primary posterior urethritis, usually of gonorrheal origin. With this admission, however, it is not desired to exclude other factors of inflammatory nature, such as might follow, for instance, prolonged congestion with the production of new fibrous tissue; nor would the writers exclude other bacterial inflammatory processes, although they believe that by far the larger number of cases follow as a natural sequence on posterior urethritis.

During the past fifteen years, since these views were published by Ciechanowski, by ourselves, and confirmed by others, the main objection brought against them has been that an acute posterior urethritis did not immediately cause prostatetic hypertrophy. This has never been claimed by us; it is the after-result of the formation of cicatricial tissue resulting from such conditions. It has also been claimed that if the pathology was as reported, cystic growth would occur with very great frequency. This is not necessarily the case, the inflammatory process being too slow a one to cause a sudden blocking of the acini, which might result in a cyst.

Apparently, not through the work of the surgeons, but by the work of the pathologists, the after-result in inflammatory conditions are being considered of more importance, both in the causation of prostatetic hypertrophy and cancer. So far as we are aware, all investigators who have made sections of the prostate, commencing at the mouths of the acini where they open into the floor of the prostate, have endorsed our views. Naturally those sections made through the center of the prostate still give rise to confusing opinions. Considerable importance has recently been ascribed to the rôle played by the periprostatic glands. Very probably they, too, are affected in a somewhat similar manner as the after result of inflammatory conditions as is the prostate itself.

CHAPTER XXVII

DIAGNOSIS AND TREATMENT OF DISEASES OF THE PROSTATE

From the preceding chapter, dealing with the anatomy, physiology, and pathologic anatomy of the prostate, the importance of the proper treatment of inflammatory conditions of the deep urethra—posterior urethritis—will be apparent. Ordinarily, the treatment must be most careful and prolonged, lest so serious a condition as hypertrophy of the gland follow as a sequel. Much of the future improvement in the treatment of prostatic diseases will undoubtedly be along the line of preventive measures. It is difficult to comprehend how such conditions as prostatic hypertrophy, with incontinence of urine, and chronic cystitis of many years' standing, altering the entire character of the mucous membrane of the bladder, could ever be cured entirely or even improved to a much greater extent than is now possible. When we consider the ill effects that follow acute inflammatory processes in the prostatic urethra, and the serious consequences that result from the formation of scar tissue, it will readily be understood that measures directed toward the prevention of such formation would prove of the greatest value. Primarily, then, all measures that tend to prevent or cure inflammatory conditions occurring in the prostatic urethra are essential. It is to be hoped that a better understanding of the serious after-effects of gonorrhea, irregularities in the sexual life, irritations from urinary deposits, and an earlier recognition of tuberculous infections will, in the future, diminish the number of sufferers from prostatic disease.

ACUTE PROSTATITIS

Symptoms and Diagnosis.—The fact that the majority of cases of acute anterior urethritis are associated with acute posterior urethritis is so well known as to require no discussion here. Either acute or chronic posterior urethritis is almost always asso-

ciated more or less with prostatitis, and with the methods at present at our command it is difficult to differentiate very closely between acute posterior urethritis and acute prostatitis. Clinically, a case of acute posterior urethritis that presents considerable swelling in or around the prostate, as ascertained by rectal touch, tenderness, painful sensations in the region of the prostate, and a feeling of weight and uneasiness in the perineum, is generally considered to be one of prostatitis. If, in addition, the urine or pus expressed by massage shows prostatic elements, the diagnosis can be made with certainty.

Treatment.—This resembles closely the treatment of acute posterior urethritis and later that of chronic prostatitis, and is very similar, also, to that of chronic posterior urethritis. In attacks of acute prostatitis attended with painful urination, and especially if accompanied by a rise of temperature, rest in bed and a light diet should be insisted on, together with the internal administration of such drugs as will relieve the pain; proper local external applications of heat or cold should also be made. If deemed advisable, leeches may be applied to the perineum, or the perineum may be blistered. No local intraurethral application should be made to the posterior urethra while acute symptoms exist. This treatment, conducted for a period of from four or five days to as many weeks, should cause the acute symptoms to subside, when the treatment of chronic prostatitis, which now ensues, should be begun. Occasionally, however, patients with acute prostatitis grow worse, and abscess of the prostate, requiring surgical interference, develops.

CHRONIC PROSTATITIS

Diagnosis and Symptoms.—The differential diagnosis of chronic prostatitis from chronic posterior urethritis is very difficult, the symptoms being almost alike and the conditions closely allied clinically. The term chronic prostatitis implies an inflammatory condition of the posterior urethra, in addition to which the symptoms pointing toward a prostatic involvement are well marked, and prostatic elements are present in the expressed secretion; in posterior urethritis the inflammatory condition is believed to be, to a great extent, situated in the posterior urethra alone.

Before making a diagnosis of chronic prostatitis, a careful examination of the urethral exudate (p. 114) should be made. A review of this condition, as the result of the examination of 116 cases of urethritis, was made by one of us in association with Dr. Blanchard, the pathologist at the City Hospital some ten years ago, and microscopic findings in cases of prostatitis so discovered exhaustively studied.[1] Roughly speaking, if the urethra has been washed out, the patient made to urinate in three glasses, then the prostate massaged, and the patient again urged to urinate, the small amount of urine collected will be found to be somewhat cloudy if the normal prostate has been massaged. If prostatitis is present, the urine will be found to be more or less coarsely turbid, and will also contain more shreds than in the cloudy urine from the massage of the healthy prostate.

The clinical symptoms, such as pain in the region of the prostate or perineum, increased frequency in urination, tenesmus, disturbance of the sexual functions, and symptoms of neurasthenia, all point toward prostatic involvement. The examination of the prostate by the rectum is useful, as, in every case of those recorded by us in the article just referred to, some change in the prostate could be made out by the examining finger. The enlargement present in the majority of cases seems to be located in one lobe, or at least most marked there.

Treatment.—This is similar to the treatment of chronic posterior urethritis; more good may, however, be expected to result from the employment of purely local measures, such as massage of the prostate; the nervous system is likely to be involved, and more attention must therefore be directed toward improving the general tone than is required in the treatment of chronic posterior urethritis. The ordinary local treatment generally consists either of irrigations or of instillations into, or of dilations of, the posterior urethra.

In commencing the treatment of chronic prostatitis it is well to tentatively make, through a small French silk catheter, a few irrigations, at intervals of from one to three days, of four ounces

[1] "Observations on the Prostate," by Robert Holmes Greene, "Journal of the American Medical Association," 1898.

of the Ultzmann solution of phenol, alum, and zinc sulphate, of each, from 1 : 1000 to 1 : 500. If these are well borne, later irrigations of silver nitrate 1 : 10,000, made at the same intervals, are recommended, or irrigations of albargin, from 1 : 2000 to 1 : 1000, may be tried. In place of the irrigations, instillations of a few drops of silver nitrate solution, one or two to one grains to the ounce, may be used at intervals of from three to five days. After the first two weeks of such treatment dilation of the posterior urethra should be performed with a Kollmann dilator, and repeated once in five days or once a week, gradually extending the size of the dilator until the urethra can be dilated to No. 40 or one or two numbers above. It is well then, if the patient can be kept under observation, to continue the dilation at intervals of at least once a month. In properly selected cases massage of the prostate may be practised as an adjunct to the foregoing treatment. If it appears to benefit it may be repeated as often as the other treatment is carried out or at separate sittings.

As previously indicated, the local treatment of these cases should extend at gradually lengthening intervals over a period of from several weeks to months, in order to be successful. Confidence on the part of the patient and patience on the part of the surgeon are requisite.

It is difficult to determine when these sufferers from chronic prostatitis or chronic posterior urethritis may be declared entirely cured. This question is practically that of the curability of gonorrhea. The absence of shreds in the urine is, so far as it goes, a good indication, but they may recur at any time, and no surgeon is justified in pronouncing a patient permanently cured because of their temporary absence. The mere fact of the presence or absence of the gonococcus in the secretion milked from the prostate, while it has some clinical significance, does not prove absolutely that a patient has or has not been entirely cured. In the first place, it must be remembered that unless the observer has had considerable experience, he may not be able, by staining methods, definitely to distinguish the gonococcus from other diplococci. Culture-tests demand a trained technician, and are carried out ordinarily with great difficulty. Then, too, the ab-

sence of the gonococcus at any given examination does not necessarily mean that it may not be again found in an examination made later.

When, under proper observation at repeated examinations, the gonococci diminish in number and finally disappear; when the amount of pus is seen to diminish and no more pus-cells appear microscopically; when the symptoms improve, so far as regards indefinite pains, painful micturition, or pain connected with the functionating of the sexual apparatus; when the urine and discharge from the prostate, obtained by massage, clear up—the patient may be pronounced as practically cured. He should then be advised to present himself occasionally for observation, and he should be informed that, as the result of dissipation or exhaustion from some intercurrent disease, his troubles may return without reinfection taking place. One of the questions often asked the surgeon is as to the probability of the former patient carrying infection to others. In giving advice on this point the surgeon should exercise care and discrimination, and should be guided by the circumstances surrounding any given case. Generally speaking, a patient should not be advised to marry unless his urethra is in such condition as to indicate cure; those who are already married when infected should also receive prohibitive advice unless the indications pointing to cure can be satisfactorily met. It should also be remembered, first, that a great many women, both married and unmarried, present somewhere in their urethral or genital apparatus evidences of a chronic inflammatory process that is not necessarily associated with any impurity on their part; and, second, that kindly nature seems to have arranged that in many cases where men and women live together they become, as it were, immune to each other's infecting organisms.

Prostatic Massage.—The value of prostatic massage in chronic prostatitis can be determined only by experiment; when properly applied, it is frequently of use. On the other hand, if improperly given or if applied to unsuitable cases, harmful results follow. The writers were among the first in this country to observe the effects of this mode of treatment. In 1894 it was adopted by the Royal Institute of Massage at Stockholm. In that year this procedure

was carried out by a graduate of that institution under the personal direction of the writers on a patient with chronic prostatitis. The observations made at that time were that the swelling in the prostate, as observed by examining it through the rectum,

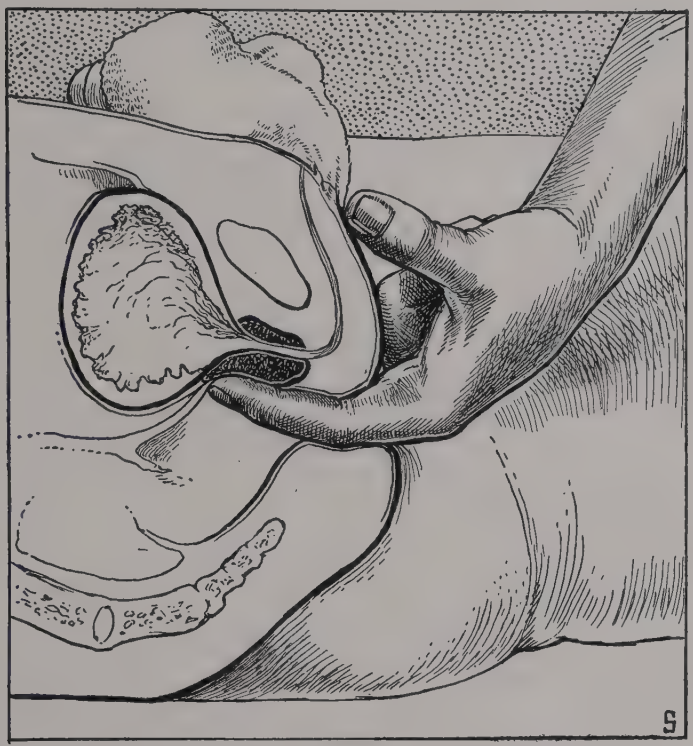


Fig. 261.—Method of performing massage of the prostate.

was thereby diminished, but that the condition of the patient was not materially improved. The method of procedure advocated at that time was to massage around the prostate with a circular rotatory motion of the forefinger, but not to massage directly over the gland itself — the same procedure, in fact, that skilful masseurs adopt for the relief of an acutely inflamed knee-joint, the object being to stimulate circulation in the part, by performing massage over the blood-vessels surrounding it, and to diminish the danger of increasing the acute inflammation by

massaging directly over it. The writers believe that this is the safest method in performing massage of the prostate. In acute inflammatory conditions, such as a very acute prostatitis or acute posterior urethritis, it is best to avoid massaging the prostate, and the same holds good as regards the seminal vesicles. Shortly after 1894 massage of the prostate came into popular use, and is still employed by many surgeons in the treatment of chronic prostatitis, the object being to press out all or a portion of the contents of the gland into the posterior urethra. As soon as the free evacuation of pus commences, the prostate may be massaged. For this purpose it is advised that the patient lie over a chair or table, that the forefinger, covered with a cot well lubricated, be introduced into the rectum, and that the region of the prostate be manipulated for from one to five minutes. This procedure is sometimes followed by a feeling of great relief and benefit to the patient, but not infrequently it is painful. If conducted too vigorously in acute inflammatory conditions, it increases the activity of the disease, frequently giving rise to an acute epididymitis. In other cases it may not give rise to acute inflammatory disturbances, but seems to render the prostatic region sore. The diminution alone in the size of the prostate, as ascertained by rectal touch, may or may not be attended by improvement in the general health of the patient. Accompanying diseased conditions of the prostate, a form of hard edema may exist between the gland and the rectal walls. The disappearance of this edema as a result of massage does not necessarily indicate that the condition of the prostate itself is much, if at all, improved. Massage of the prostate is seldom employed alone in the treatment of chronic prostatitis. As a rule, it is used in conjunction with intraurethral applications to the prostatic urethra. If its use, once or twice a week, alone or combined with other measures, is followed by a sensation of relief and a feeling of betterment, and if the inflammatory condition of the prostate subsides under its use (indicated by a diminution of the inflammatory products of the discharge that is massaged into the prostatic urethra and passed out on urination), it should be continued for several weeks or months at gradually increasing intervals. A study of the pathology of the inflammatory condi-

tions that occur in the prostate helps to explain the otherwise apparently contradictory conclusions often arrived at as the result of prostatic massage. There are three classes of cases:

1. In those who suffer from pathologic hypertrophy of the prostate massage is of no benefit, for the reason that in these cases the mouths of the acini are occluded by inflammatory products, thus preventing the expression of the prostatic secretion. The aged generally make up this class.

2. A mixed class, in some of whom the orifices of the acini of the prostate are so occluded by inflammatory products that their contents cannot be expressed, while others of the acini have inflammatory products dipping down into them, the mouths of the acini, however, being still pervious. Clinically, in these cases, as in the previous class, it is noticed that massage of the prostate renders the prostatic region sore, although, judging from the amount and character of the secretion expressed, it would be natural to presume that the effect of the massage was beneficial.

3. This class consists of those in whom the inflammatory products have dipped down into the prostatic acini, but enough scar tissue has not as yet formed to obliterate the mouths of any number. It is among the members of this class that the best results from massage of the prostate are observed to follow. A well-known surgeon of Berlin has devised a method of performing massage of the prostate that apparently has much to recommend it. It is his custom, in cases of posterior urethritis or prostatitis, to search with his finger in the rectum for a soft spot in the prostate. If it is found, he massages the rectal wall over the soft spot with a scratching motion, leaving the remainder of the prostate untouched.

The writers' conclusions concerning the use of massage of the prostate are:

First: That it should not be attempted in every case of chronic prostatitis, but should be tentatively employed in carefully selected cases, when, if apparently attended with good results, its use should be continued.

Second: That the examination of the prostate itself, by the rectal touch alone, is not necessarily a satisfactory guide as to whether improvement has followed massage.

Third: That the older the patient, the less likely is prostatic massage to be of benefit.

Fourth: That in performing massage it is more advisable to massage around the prostate or over any softened or boggy area than to attempt manipulations over the entire surface of the gland.

General Treatment.—*Neurasthenia* is so often associated with conditions of chronic inflammation in the prostate that its nature and its effects on the whole urinary and genital tract should be better understood by the surgeon. Although neurasthenia is rarely directly productive of anatomic diseased conditions, a very slight lesion of the prostatic urethra or the prostate, accompanied by general neurasthenia, will be extremely difficult to cure, or to materially benefit the prostatic lesion, by even the most skilful local treatment, unless the surgeon is also successful in the treatment of the neurasthenia. If the nervous condition is properly treated and the lesion is slight, the patient may be unaware that any prostatic disorder existed.

Hypochondriasis is a more serious condition, and care should be taken to differentiate it from neurasthenia. It is very often associated with the latter, and may become intensified as the neurasthenia improves. It may, of course, occur without any accompanying neurasthenia and without the occurrence of any lesion in the urethra or prostate. Neurasthenia is becoming recognized more and more as an entity with a physical basis, and is often associated with anemia and lowered circulation. In many cases worry, mental or surgical shock, or an infectious disease, such as malaria, plays a part in its causation. Hypochondriasis, however, seems associated with a perverted mentality, without evincing any anatomic lesion that is at present recognizable.

It is well, therefore, in treating any lesion of the prostate or of the prostatic urethra, to examine carefully into the general condition of the patient, and to improve any existing lowered condition of circulation or nerve tone. Life in the open air, cold baths, either plunge or sponge-baths, drip sheets, golf, tennis, and above all swimming,—the latter exercise being a good one for developing the muscles of the perineum,—are to be recommended in suitable cases. An examination of the blood is often of value in directing

the general treatment. If malarial plasmodia are found to be present, quinin and arsenic are necessary; or if anemia is discovered, the nonirritating form of iron salts may be given. Apart from its value as a general tonic, iron is apparently of great service for its local action on the neck of the bladder. It may be given as the tartrate of iron and potash or combined with quinin, manganese, nux vomica, ignatia, or coca. The glycerophosphates of calcium seem often to do good. They should be given in large doses, continuously, or at intervals extending over a period of weeks and months. Owing to the intimate relations that exist between the prostate and the rectum, care should be exercised that the bowels are kept freely open. It is better, when possible, for this purpose to rely on diet and exercise than on powerful laxatives. A milk diet may, for a short time, be advisable in certain cases, and ordinarily, in patients with prostatic irritation, a sufficient but economic diet, consisting of a moderate amount of meat and green vegetables, with milk in some form at certain hours of the day to keep up the fat-supply, is advisable; foods rich in starch or sugar should be taken sparingly. Strawberries, and particularly asparagus, are known to be irritating to the mucous membranes of the tract, and should therefore be avoided, as should also highly seasoned articles of food. Alcohol, unless taken in very small quantities well diluted, is not advisable. Red wines are generally too acid, the light white French wines, which are not sweet, and the light Moselle wines, diluted with water, are less harmful. The various carbonic waters, such as artificial Vichy, now so freely used, frequently tend to aggravate or may even provoke irritation of the neck of the bladder if indulged in excessively.

Of the resinous substances having a direct effect on the mucous membrane of the neck of the bladder, tending to allay irritation, kava-kava is among the best. Dram doses of the fluidextract of kava-kava well diluted in water, and given three or four times a day, are often of benefit if tolerated by the stomach. If the urine is scanty, with a high specific gravity, spiritus ætheris nitrosi in half-dram doses several times daily is of benefit, and salol and urotropin are often useful. They are well borne when combined

in the same capsule. Sandalwood oil, alone or with kava-kava, or powdered cubebs with sodium bicarbonate, sometimes has a soothing effect. Dram doses of the latter stirred up in water are well borne by the stomach and are occasionally of benefit. When there is marked nervous irritability, with frequent micturition, but no lesion of any magnitude, tincture of cantharides, in one-drop doses administered several times a day, may be used with advantage. For the relief of pain tincture of hyoscyamus or suppositories containing opium or belladonna are occasionally required, and suppositories of ichthyol may sometimes act well in helping to overcome congestion. It has been the custom, in the past few years, to recommend hot rectal irrigations for the relief of inflammatory conditions at the neck of the bladder, and a great many different apparatus for carrying out this treatment have been invented; the writers have found, however, that as good results can be attained otherwise, with less trouble and annoyance to the patient. Apparatus for applying cold to the rectum have also been devised, but have never come into general use, nor do we recommend them.

In our experience extensive operative procedures, except for abscess of the prostate of some considerable size, reference to which will be made in the following article, are unnecessary for the treatment of this condition. That such operation can be performed as partial prostatectomy without serious after-results, and that in certain cases improvement in the general condition of the patient may follow, is not disputed, but our experience along two different lines has led us to the conclusion expressed above. Working along one of these lines of investigation we find if these patients can be kept under observation, the deep urethra dilated with a Kollmann dilator, irrigations of nitrate of silver, which are not strong, used once or twice weekly, and the general tone of the patients improved through proper hygienic measures, unless tuberculosis or some other intercurrent disease is present, such patients improve rapidly and permanently. It is in just such cases that massage of the prostate seems often to be overdone, and not infrequently patients are found who have also been overtreated in other respects. The other factor to

which we wish to call attention is that of time. Patients are occasionally seen by us who have had marked prostatitis many years previously, who have come under observation, improved somewhat under treatment, disappeared from view, and after several years' absence reappeared to be treated for some other condition, give a history of having had no treatment during the interval, and in whom the prostate has been found to be in a healthy condition.

ABSCESS OF THE PROSTATE

Various forms of abscess of the prostate may be seen clinically, but the pathologic anatomy of all is very similar. It is only the large abscesses that give rise to serious disturbances. They occur at any age, and are occasionally of tuberculous origin. The most common form is that which accompanies or follows an attack of acute urethritis. In a large majority of cases the abscess, if allowed to run its course, will burst into the floor of the prostatic urethra, as described in a previous chapter; when this occurs, healing may follow, or as more frequently happens, a chronic prostatitis may be set up. Clinically, an abscess presents all the symptoms of an intense posterior urethritis, the prostate being sometimes enormously swollen and tender to the touch. Very often a soft spot or a dimple-like depression can be felt upon its surface.

It is best treated by rest in bed, the internal administration of urinary antiseptics, sedatives and opium, if necessary, in sufficient quantities to relieve pain. Such patients usually complain of a sensation as if a cannon ball were suspended between their legs. If the abscess does not open into the floor of the urethra, it may burst into the rectum or through the perineum. In doubtful cases it is best to watch the development and course of the abscess for some time before proceeding surgically. If the symptoms become worse, the patient losing weight and strength, with indications of the onset of septicemia, and if the abscess displays no tendency to open into the urethra, operative procedures for its relief must be considered.

A prostatic abscess may be opened from within the urethra, by the method the writers prefer for the treatment of hypertrophy,

i. e., the Bryson method, which is fully described elsewhere; or it may be opened by way of the perineum. At times a simple semilunar incision is all that will be required, as the swollen prostate may bulge toward the perineum. The prostate being exposed through one of the incisions named in the previous chapter, a knife should be pushed into the bulging portion, the pus evacuated, the cavity washed out, and drainage instituted for a few days. Opening the prostate through the rectum for the relief of abscess, so frequently recommended in the earlier text-books on surgery, is a bad procedure and should not be resorted to.

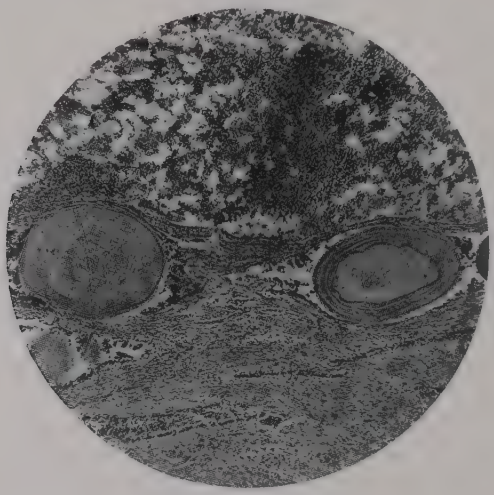


Fig. 262.—Microphotograph showing corpora amylacea in abscess of the prostate.

A good plan, before performing any serious operation on the prostate, is to massage the gland carefully, with a finger in the rectum, and see if pus can be expressed. The writers have seen cases of prostatic abscess of considerable size, in which, as a result of this massage, large quantities of pus were expressed, the volume of the prostate, as felt by the examining finger in the rectum, being immediately greatly reduced and a favorable course followed.

Occasionally an abscess is found associated with, or simulating, the prostatic hypertrophy of the aged; small prostatic abscesses are also often a part of or associated with posterior urethritis.

In these cases, massage of the prostate, if skilfully performed, followed by irrigations with weak silver nitrate solution (1 : 10,000), may be of benefit. This treatment should be repeated at intervals of from two days to a week, and should cover a period of several months; later the posterior urethra should be carefully dilated by means of a Kollmann dilator. Attention should also be directed toward improving the health and strength of the patient. The pus should be examined for tubercle bacilli. In large prostatic abscesses of tuberculous origin, the surgical treatment is that of abscesses due to other causes. When the presence of tubercle bacilli has been demonstrated, the patient should be placed amid the most favorable hygienic surroundings. In these cases not much is to be expected from local measures. Irrigations of mercury cyanid may be tried, or instillations of gomerol may be used. Silver nitrate will be found to be too irritating.

Abscesses of the prostate have been reported following carbuncle on the neck in patients who had never had gonorrhea. They have been reported as causing edema of a septic nature in the cavity of Retzius. They may follow pyemia or the grip. Mr. Harmonic[1] considers diabetics are particularly liable to have abscess of the prostate. Mr. Minet, at the same meeting, considered the question of periprostatic abscesses, and found them most often retroprostatic, retrovesical, or lateroprostatic. We have recently operated on one case of this description, apparently of gonorrheal origin. It has been thought by some that these prostatic abscesses might remain latent for a number of years and then show themselves. This view is probably true to some extent, but the anatomic investigations which have been carried on by us, and to which reference is made earlier in the chapter, tend to show, if abscesses of the prostate are not so extensive as to give rise to sepsis and demand immediate operation, in the course of time the cavities become filled with cicatricial tissue.

PROSTATIC CALCULI

Generally speaking, two varieties of prostatic calculi may be said to occur: one variety, that almost invariably comes from a focus in the bladder, becoming later attached to the walls of

[1] "Eleventh Session Assoc. Française Urology."

the prostatic urethra, and surrounded by urinary salts, generally phosphatic in character. These are, to be accurate, urethral rather than prostatic calculi. In the other form the stones are formed as the result of obliteration of the mouths of the acini and the calcification of their retained exudate. They are generally found in elderly persons. If they give rise to symptoms of distress and inconvenience, they may be removed by making a perineal incision and digging them out from the prostatic urethra, in a manner similar to that by which the large lateral lobes are removed. A third variety of prostatic calculi are occasionally seen; these are phosphatic in character, extremely minute, and resemble somewhat the scales of a very small fish. They are to be found lining the posterior urethra and dipping down into the prostatic follicles. When necessary they may be removed through the ordinary perineal incision, such as would be made for a tight stricture. Clinically, their presence may be discovered upon examining the urine, or on their striking the end of some instrument, such as the Thompson searcher; or they may be observed under the endoscope. The same methods will serve to show the presence of the impacted larger prostatic urethral calculi, first mentioned, whereas the true prostatic calculi forming in the body of the prostate can sometimes be diagnosed by making a rectal examination at the same time that the instrument is introduced into the bladder. Occasionally, gravel passing out of the bladder into the prostatic urethra on its way down from the kidney will give rise to pain and distress, causing a spasm of the prostatic urethra which may be so severe as to provoke hemorrhage. For the relief of the spasm the patient should be ordered to urinate while lying in a warm bath; large quantities of fluid should be drunk, and hyoscyamus, kava-kava, and perhaps glycerin in large doses, administered.

PROSTATIC HYPERTROPHY

Diagnosis.—As has been pointed out, prostatic hypertrophy, anatomically speaking, instead of being confined to the aged, as is commonly believed, may occur in comparative youth, provided severe inflammatory processes have previously existed in the prostatic urethra. If this enlargement is extensive enough, it will interfere somewhat with the complete emptying of the bladder. Prostatic

enlargement of so severe a degree may exist that, after urination, several ounces of urine may be retained, without giving rise to clinical symptoms of any importance if the urine does not become infected, and if the patient does not become exhausted as the result of intercurrent disease. If the bladder muscle and the fibers surrounding the neck of the bladder and the prostate are weakened because of some systemic disorder, then prostatic obstruction may cause retention. If acute inflammation attacks the base and neck of the bladder as the result of infection, as from gonorrhea or following the passage of an unclean instrument, an enlargement of the prostate tends to retard recovery from such inflammation. Such cases are frequently encountered, very often presenting no marked clinical symptoms except a slight chronic posterior urethritis that does not yield readily to treatment, and the presence of residual urine varying in amount from one to eight ounces. It is sometimes difficult, in these cases, to determine what form of prostatic enlargement is present—whether of the lateral lobes, the third lobe, or of both. In most enlargements, however, the two side lobes are involved to a greater or less extent. The form of prostatic enlargement may be determined, or diagnosis aided, by introducing a catheter into the bladder and passing it back to the posterior surface of the viscus. All the urine in the bladder, or the residual urine, if the patient has urinated, should be allowed to run out through the catheter, which should then be withdrawn very slowly. After one or two inches of the catheter have been returned, more urine—from 2 drams to 4 ounces—may flow out of the end of the instrument, tending to show the presence of a pocket in the bladder, often due to a third lobe enlargement. On withdrawing the catheter still farther, only a few drops—a half dram or so—of urine that may have remained within the urethra will escape. In examining a patient, with chronic retention, if a large amount—over eight ounces—of residual urine is found, the bladder should not be emptied completely at the first examination, unless some other fluid is injected in place of the urine, as the too sudden emptying of an overdistended bladder may give rise to cystitis, hemorrhage, or shock.

The diagnosis may sometimes be made by passing a Kollmann

dilator into the bladder and screwing it up about No. 30. A contraction will be felt, offering a very strong resistance to any further distention of the neck of the bladder by the dilator. It is often possible, in these cases, to dilate to within one number of the point at which the contraction is felt without producing discomfort, and without any marked difference being noticed as regards obstruction to the distention of the instrument up to that point. At that particular point and beyond strong resistance is met. Ordinarily this is evidence either of stricture at the bulbomembranous junction or of the results of inflammatory conditions deeper in toward the neck of the bladder, conditions not infrequently found associated with prostatic hypertrophy. In healthy urethras No. 40 can often be reached on the scale of the dilator without contraction becoming apparent. A searcher may be passed, rotated to one side and withdrawn until it is caught, then rotated to the other side of the bladder, and the same procedure gone through, any difference to the extent it can be withdrawn being noticed on the marker on the searcher, also completely rotated and then brought forward. By this means the approximate size of the prostate may be arrived at. It should also be examined with a searcher or sound in the bladder and a finger in the rectum, and, finally, in a doubtful case, the view obtained through the cystoscope will be of great diagnostic aid to the competent observer.

In making a diagnosis of prostatic hypertrophy care must be taken not to confound the difficulty in micturition due to this condition or to stricture with that due to diseases of the nervous system or of the kidney, or to simple muscular weakness due to age or exhausting disease of the bladder-wall. Ciechanowski has found, by making careful measurements of the bladder muscular tissue, comparing the bladder-walls of the aged and of the young, that there is likely to be a diminution—a very large one, of some 50 per cent. or more—in the amount of muscular tissue of the bladder-wall of the aged, even when no acute inflammatory condition of the bladder-wall exists.

Symptoms.—The clinical symptoms of prostatic hypertrophy have been previously mentioned and are generally well understood. The most prominent are increased frequency in micturition,

PLATE XVI

Hypertrophy of the lateral lobes of the prostate with the tumor presenting inside the bladder and showing an oval calculus lodged in a sacculation posterior to the enlarged prostate. (From a specimen in the Carnegie Laboratory Museum.) (Natural size.) *a*, Thickened and inflamed folds of the bladder mucosa; *b*, calculus lodged in sacculation of the bladder wall; *c*, enlarged lateral lobes of prostate; *d*, root of the penis showing slight degree of enlargement of prostate outside of bladder.

with apparent loss of muscular power to perform the act, the increase being most noticeable at night or toward early morning; diminution in the size of the stream, and, following attacks of cold or of dissipation, very probably a history of retention.

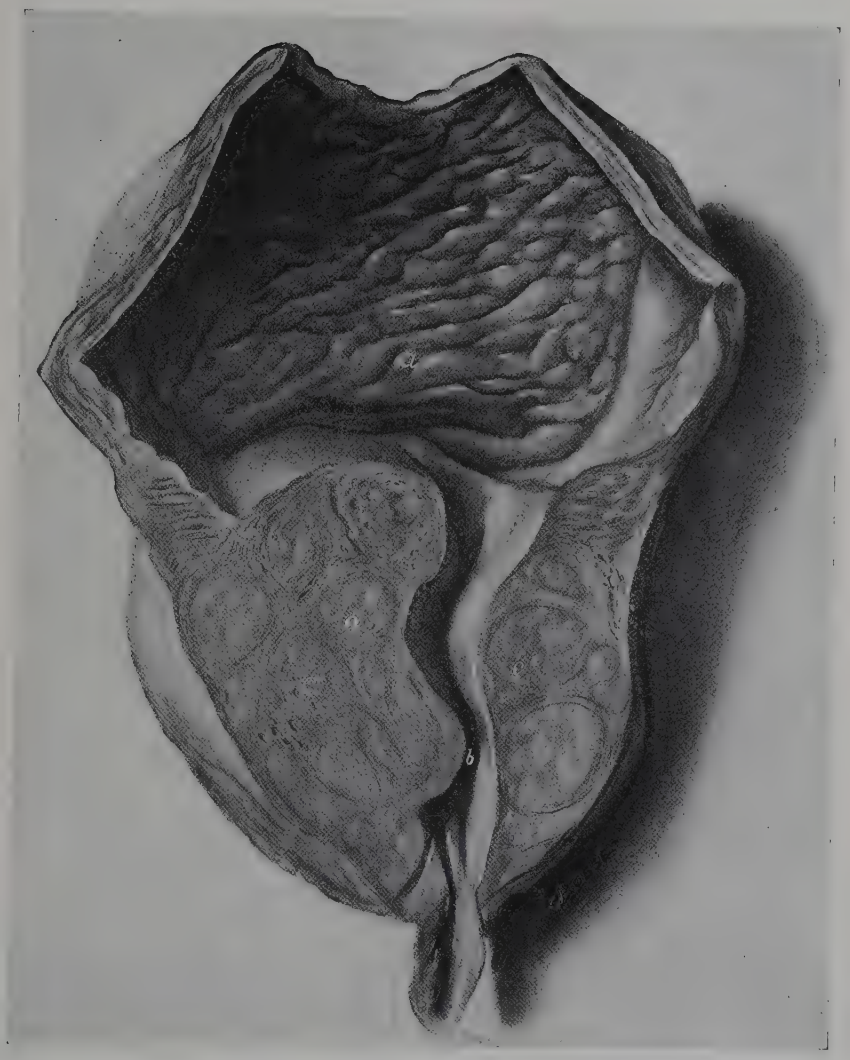
In those cases presenting the clinical appearance of chronic posterior urethritis, together with a resistance to a Kollmann dilator in the prostatic urethra at about No. 30 French, associated with retention of urine—from 4 to 8 ounces—and proving rebellious to the simple treatment of posterior urethritis—that is, not showing a marked tendency to get well under hygienic treatment, as ordinary cases of posterior urethritis often do—we may be quite sure that we are dealing with prostatic hypertrophy. The cases of so-called chronic contraction of the bladder neck, as described by some specialists, are to be found in this class. There is no reason why, anatomically, there should not be chronic contraction of the bladder neck. The old belief that stricture, meaning by that the formation of scar tissue, could not exist in the prostatic urethra was found to have no anatomic foundation. The scar tissue forming in the deep urethra may give rise to the so-called third lobe enlargement or enlargement of the lateral lobes of the prostate in the manner already described. It may also, through infiltrating into the surrounding tissue, cause bands of cicatricial tissue to form in the prostatic urethra. Bands do occasionally exist, but are of comparatively rare occurrence. The writers believe that these cases, which have been considered by some observers under the heads of chronic contraction of the bladder neck, are due chiefly to third lobe prostatic enlargement; but whether due to this or to infiltration of scar tissue in the prostatic urethra, the writers have never seen any uncomplicated case that needed operative treatment for its relief, beyond such as might be furnished by dilatation with the Kollmann dilator and treatment of any accompanying posterior urethritis.

Treatment.—Dilatation of the prostatic urethra at intervals of a week or two weeks, carefully performed by means of the Kollmann dilator, together with or alternating with solutions of silver nitrate of varying amount and strength, and proper constitutional treatment, will benefit very markedly those cases of contraction at the neck of the bladder for which no radical operation is re-

quired. These same measures are the ones to be adopted in almost any case of prostatic hypertrophy, in the hope that, through distention of any cicatricial tissue, some of the acini may be opened, and the neck of the bladder toned up to the point of recovering its energy and properly performing its functions. Sounds should not be used, as their introduction injures the prostate. Irrigations of weak solutions of silver nitrate (1 : 10,000) ordinarily give the best results. Great care and gentleness should be used in the introduction of the Kollmann dilator. At first the instrument should not be distended to more than No. 30 to 32, at which point generally considerable resistance will be met with. At each application it should ordinarily be distended one or two points more, until a distention of from No. 40 to 44 can be obtained. It should be allowed to remain in the bladder for not more than one to three minutes on each introduction.

If treatment along the lines indicated fail, after it has been thoroughly tested over a period of weeks or months, and the disturbances incident to the prostatic hypertrophy increase, as shown by a more frequent demand for the use of the catheter on account of complete or partial retention, two modes of procedure are open to the patient. One is to adopt the so-called catheter life, and the other is to undergo a radical operation for the relief of the prostatic obstruction. So much has been written concerning catheter life that nothing remains to be said. Fortunately, in our experience the members of this class are growing fewer in numbers and more and more often do we find them at least greatly improving under appropriate local and general treatment, but some few exist. The surgeon, some member of the patient's family, and, later on, when possible, the patient himself, may draw the urine by means of a soft-rubber, velvet-eyed catheter of the smallest size that will empty the bladder without consuming much time. If the velvet-eyed soft catheter is introduced with difficulty, the Mercier or a bicoudè may be used instead. Before using, the catheter should be carefully sterilized by immersing it in boiling water. Sterilized white vaselin, which is sold in small tubes, makes the best lubricant for these cases. The frequency with which the catheter must be used will depend upon the indi-

PLATE XVII



Senile hypertrophy of the prostate, showing resulting tortuous stricture of the posterior urethra and atrophy of the bladder. (From a specimen in the Carnegie Laboratory Museum.) (Natural size.) *a*, Atrophied bladder showing hypertrophy of the rugæ; *b*, urethra; *c*, encapsulated "adenomatous" nodules of enlarged prostate.

vidual case. Early in the history of their catheter life patients may be able to use the catheter three times a week; the intervals are gradually shortened until it is used daily, and then every six to eight hours. It was generally believed, in the past, that, after emptying the bladder, it was a good plan twice a day, daily, or two or three times weekly, to wash out the organ. In certain cases, probably, the bladder is washed out too often. Each case should be a law unto itself. Of the solution to be used for bladder lavage, boric acid is probably to be preferred; in some cases listerine, well diluted, or salt and water may be used; ordinarily unirritating and unstimulating preparations give the best results. Oxycyanid of mercury 1 : 5000 may be tried. If the patient does not do well on the catheter life, a radical operation for the cure of the prostatic enlargement may be attempted. Beyond the discomfort and annoyance incident to the use of the catheter, patients may continue its use for years without manifesting any serious disturbance. One patient under the writers' observation has been obliged to use the catheter for twenty-five years. In many cases, on the other hand, the adoption of catheter life seems to be the beginning of the end. Within a few months or a few years recurrent attacks of cystitis, associated often with pyelonephritis, occur, and a general septic condition, followed by death, ensues. What relief, then, can conscientiously be offered any prostatic case that has reached a point at which the posterior urethra will no longer react to stimulating measures, such as dilation or irrigations, and where the neck of the bladder cannot be made to recover its tone?

The death-rate following operation for the relief of a prostatic enlargement is comparatively small. In well-selected cases it should not, if properly performed by one of the methods advised, be above 5 per cent. In a series of operations that may be called emergency operations, which must be performed for the immediate relief of a patient suffering from prolonged retention, and in which a general septic condition is present, the death-rate will naturally be higher, a fact that should not be set down as due to the operation. The writers are inclined to recommend emergency operations—that is, if a patient with retention due to prostatic hypertrophy is in such a condition that a perineal

section or a suprapubic cystotomy is required for the relief of the condition, they consider it good surgery ordinarily to remove the prostate at the same time, through the same opening, by one of the methods about to be described.

What can be promised in regard to improvement in selected cases if recovery from prostatectomy ensues? In performing a radical operation on a man who has a distended bladder and is obliged to depend upon the catheter, who has had chronic cystitis for many years, with a thickening of the bladder-walls and incontinence of urine due to the cystitis, a certain amount of relief can be promised and the dangers of sepsis lessened. It cannot be promised, however, that the bladder-walls will lose their thickening, that the mucous membrane of the bladder will become the same as that of a young man, that the muscles of the neck will soon recover their tone, or that a man who has been unable to control the act of urination for a long time will recover that power and never again exhibit residual urine. A well-selected case, receiving proper after-treatment, will probably be benefited, so that the patient's condition, say three months from the date of the operation, will be better than it would have been if the operation had not been performed. To a man about to begin the catheter life, who still has some control over the muscles at the neck of the bladder, who is not entirely dependent upon the catheter, although he may have had a few attacks of retention, more hope of relief can be promised, or at least expected. The muscles may so recover their tone that he will not be subject to retention, and he may be able to empty his bladder, the danger of sepsis will be averted, his condition be rendered more comfortable, and the catheter life may be entirely avoided or postponed and life prolonged. As regards the sexual function, if it is not already gone, it is likely to become lost, although not necessarily, as a result of the operation. This should be clearly stated to the patient before operating either in emergency or in selected cases. There is some slight danger, apart from the danger of death immediately following the operation, of a rectal or suprapubic fistula being left behind, and recurring unpleasant attacks of relapsing orchitis or epididymitis are quite likely to follow.

Our greater personal experience obtained since the earlier editions of this work have cleared our ideas as to what should be done for the relief of an individual suffering from an enlargement of the prostate. Each case to a greater or less extent has to be considered on its own merits, outside surroundings modifying to a degree the treatment that should be instituted. We believe that the class of men at present leading the catheter life will gradually grow smaller and smaller, not necessarily, however, from an increased number of operations for the removal of the entire prostate, and we believe that to some degree the lives of the individuals at present requiring a so-called emergency operation will be prolonged from a better understanding of methods of treatment previous to the operation, clearer ideas as to the amount of the prostate to be removed at the operation, and a better understanding of the proper after-treatment. The question of drainage being one of the most important factors, when properly understood, that will aid in reducing the mortality among these people. We frequently have under our care individuals with from 4 ounces to 1 pint of residual urine, with a history of from one to three attacks of complete retention, who, under the proper general and local measures previously mentioned become able to entirely empty their bladders, and who become, as far as symptoms are concerned, entirely well, the frequency of urination at night becoming normal. The above represents the class of cases from which the ranks of those who lead a catheter life have in the past been recruited, and who are at present frequently subject to operation for the entire removal of the prostate, and who are not, even when the operation is most skilfully performed, constitutionally eventually benefited by such operation. In our observation, even if it relieves their difficulty in micturition, it seems in some way to sap their nervous force, and if such an expression is excusable, take the "steel from their blood." The class of patients is more rarely seen in which such a condition as recurring hemorrhage necessitates the removal of their enlarged prostate. In our observation where malignancy is not present this is generally found among those far advanced in years. Removal of their prostate, provided they recover from the shock of the operation, tends to prolong their life and render them com-

paratively comfortable. The second class which requires operation is the class in which the so-called emergency operation has to be performed. This class is more often met with in hospitals, but is occasionally seen in private practice. The prostatic hypertrophy in these individuals has become so marked as to render their prostates enormous in size, and they may project in varying shapes into the bladder; associated with these is generally a large amount of residual urine. We have had several cases come under our care recently in which 2 quarts were present; these individuals have nephritis and often hydro- or pyonephrosis. They require drainage, and frequently the removal of the obstruction either at once or by a two-stage operation. Operative procedures in such individuals generally for the removal of all or part of the prostate tends to prolong their existence. The prognosis should be guarded, as these patients, whether they are operated upon or not, are apt to live but a short time.

Operation.—Only two methods of relief by operation on the prostate will be here considered in detail: the intra-urethral and the suprapubic. In addition to these two methods of removing the prostate, a general method of operating has been described, by means of which, through a perineal incision, the rectum may be separated from the urethra, prostate, and seminal vesicles, making a road by which any of these organs may be reached. Removal of the prostate from without the capsule, though not recommended, may be effected in this way.

For the operative work on the prostate in this country great credit is due to John P. Bryson, of St. Louis, and to Samuel Alexander, of New York. Dr. Bryson, about two years before his death, wrote a paper describing certain methods of operating on the prostate; in this he stated that at that time he had operated on 116 cases. So far as can be determined, the methods employed by these two operators are very similar, if not identical. The procedure consists of digging out the lateral lobes and the third lobe of the prostate with a finger inside the prostatic urethra through an incision such as is ordinarily made in the perineum for the relief of urethral stricture, and that has been described under that heading (page 466). An incision having been made through the perineum and through the urethra on to a guide

placed in the bladder, the guide is withdrawn, the finger introduced into the wound, into the urethra, and as far into the bladder as possible. With the other hand over the pubes, the surgeon

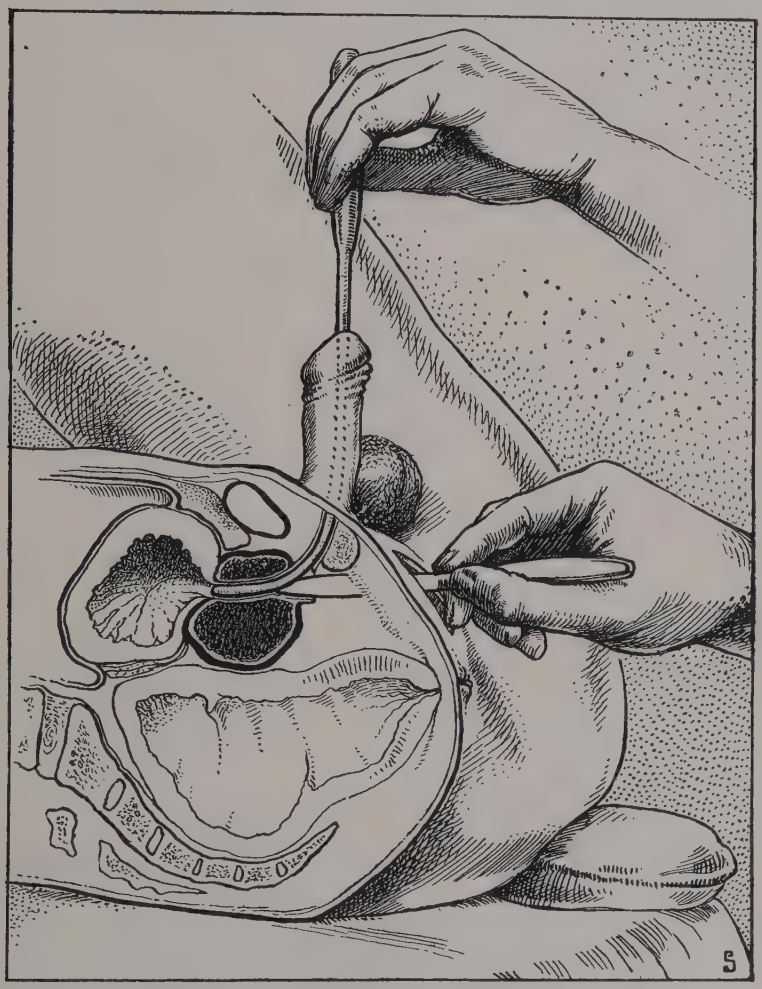


Fig. 263.—Bryson's operation for relief of prostatic hypertrophy. The staff is introduced and incision into apex of prostate being made.

pushes down the bladder and the prostate so far that they can be made to meet the finger in the urethra. It will generally be found, on introducing the finger into the urethra, that quite

a tight contraction can be felt just ahead of the tip of the digit. Generally, in an enlarged prostate, the prostatic urethra is necessarily lengthened and contracted as a result of the growth. In this case there may not be room enough to allow the finger to meet the bladder-wall, and the surgeon should cut down upon the floor of the urethra, with a small narrow bistoury, as near the anterior part of the incision as is required. If necessary, he may cut a little farther back, so as to slightly loosen the surrounding tissue, thus assisting the finger well up into the prostatic urethra and mouth of the bladder. Great care should be taken during the entire procedure—and this is most important—not to wound the rectum, thus avoiding the formation of a recto-urethral fistula. An assistant may introduce a finger into the rectum, or, while this nick is being made on the floor of the deep urethra, the surgeon may insert his finger, covered with a glove. Instead of cutting, a Kollmann dilator may be placed in the bladder and the prostatic urethra dilated to No. 45. This may be done before or after making the perineal incision. Any bands in the prostatic urethra having now been dilated or incised sufficiently readily to admit the forefinger, a nick should be made in the wall of the urethra on each side from the inside. It is important to remember that this slight cut is made from inside the urethra out into the side lobes of the prostate. Just as a nasal surgeon operating on the nose by means of a probe breaks into the ethmoid cells, a surgeon operating on a case of prostatic hypertrophy should break through the urethral wall, working from the inside with his finger into the cells of the prostate lying on each side of the urethra. Any instrument desired may be used to make the first nick, a blunt-pointed instrument being better than a knife for this purpose. The writers employ a periosteal elevator. Having made the nick, the surgeon should work his finger into the opening, keeping up the counter-pressure with the other hand over the bladder, and, by moving his finger about, bring up whatever prostatic mass he may encounter. The ease with which the mass or masses often shell out is astonishing. They resemble small uterine fibroids. Having shelled out all the masses into the prostatic urethra, and having freed them from any attachments, a dressing forceps should

be introduced into the urethra from the perineal wound, and the pieces removed through the perineal opening; the finger should then be inserted into the perineal opening, into the prostatic ure-

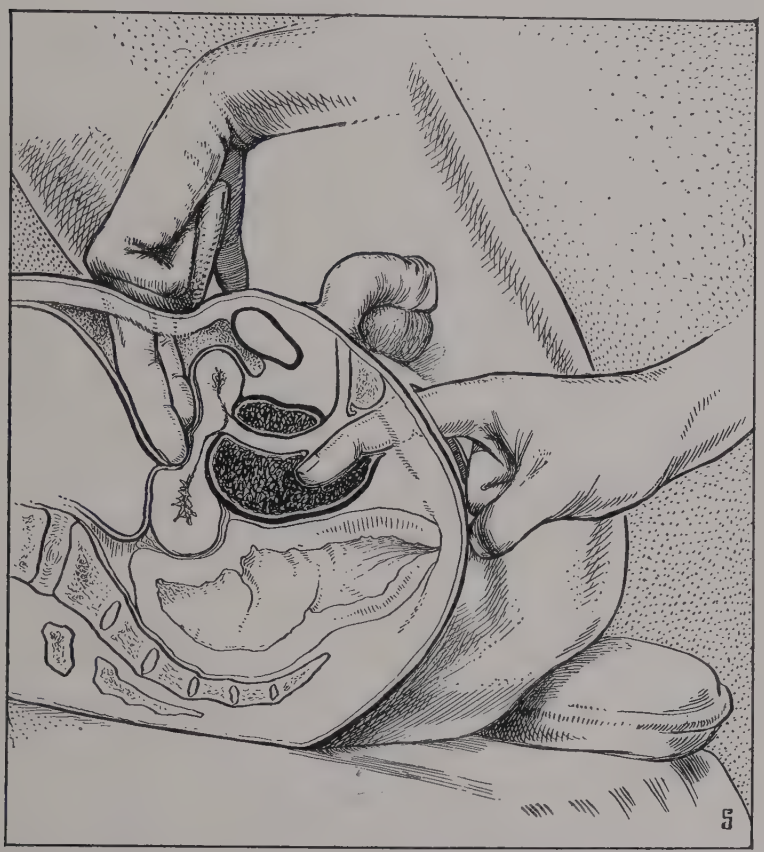


Fig. 264.—Bryson's operation for relief of prostatic hypertrophy, showing forefinger of right hand enucleating while first and second fingers of left hand are making counter-pressure from space of Retzius. Neither bladder nor peritoneum have been opened.

thra, and into the opening in the side of the urethra again, to ascertain if any more masses exist. One side having been cleaned out, a slit should be made in the other side of the urethra, and any growth remaining there removed. The masses may be single and the size of a marble, or they may be so large and so numerous as to fill a coffee-cup, this being dependent on the size of the pros-

tate. It may not be necessary, if the nicks are made on each side and a third lobe enlargement exists, to make another opening at the base of the third lobe in the floor of the prostatic urethra and enucleate this, for the surgeon's finger in one or both of the side nicks will probably work its way toward the front far enough to enucleate the third lobe through one of the openings made in the urethra from which the side lobes were removed. If one remains it may be removed through a slit at its base, in the same manner as removal of the side lobe was effected. It will be noticeable that, as the enucleation proceeds and the bunches are removed, the prostatic urethra will become more and more flexible and less rigid, and that the hand on the abdomen, above the pubes, pushing the neck of the bladder to meet the finger in the urethra, will meet less and less resistance. This point is important, for if the prostatic urethra can be reached by the surgeon's finger so that a nick can be made in the side of it and the enucleation proceed, while the hand above the pubes, the bladder being empty, presses the prostate down from above, the necessity for making any suprapubic opening may be avoided. If the prostatic urethra cannot be reached,—it is generally only in very fleshy subjects that this is the case,—a suprapubic incision should be made, just as would be done if suprapubic cystotomy were to be performed, except that the bladder need not be opened. When the bladder is reached, the gloved hand of an assistant may be placed in the prevesical space just above that viscus.

This is quite roomy, and through it the neck of the bladder may be pushed down toward the operating finger.

Dr. John P. Bryson was the first operator, so far as is known, to discover this method of utilizing the prevesical space.

In some cases, particularly in the infirm, the very aged, or in certain emergency operations, it may be well to perform a preliminary suprapubic cystotomy, and, at any time within the following week, probably within the next day or two, to remove the prostate through an incision in the perineum by the method just described. In such cases an assistant's finger is introduced into the bladder, pressing the prostate down toward the perineum, thus making it easier for the operator, with his finger in the perineal wound, to reach the prostatic urethra.

Ordinarily, however, it is not necessary either to open the bladder or to pass a hand into the prevesical space. After the operation an ordinary perineal tube, of the size of the largest catheter, should be introduced into the bladder, the end being allowed to protrude through the perineal wound. Strips of gauze should be carefully packed all around the tube introduced through the prostatic urethra into the bladder, to lessen the danger of secondary hemorrhage. Before introducing the tube the cavities from which the portions of the prostate have been excavated should be dried as carefully as possible, and the finger, well smeared with 10 per cent. iodoform in vaselin, should be applied to their surfaces in a thorough and painstaking manner. Iodoform, 10 per cent., dissolved in vaselin and melted, should also be injected through a glass syringe between the dressing on the tube and the urethra. For this suggestion, which we consider an excellent one, we are indebted to our friend Dr. Henry H. Morton, of Brooklyn, the idea having been conceived by his associate, Dr. H. E. Frazer. The hemorrhage at the time of the operation is slight and easily controlled by douches of warm salt solution. At the end of six days the perineal tube may be removed, the wound allowed to granulate as after an operation for stricture of the urethra, and the patient permitted to get out of bed. This method of operating has been criticized by some because of the danger of wounding the rectum. This accident is the result of either carelessness or ignorance on the part of the operator.

Among the many advantages of this operation are the following: It is, when properly conducted, a simple operation; it does not remove or cut through any more muscle or capsule than is required; if it does not remove the whole prostate, so much the better, so long as it removes the part that is diseased. The various operations that necessitate going outside the prostate through the perineum seem a little more heroic than the exigencies of the ordinary case demand for the relief of prostatic hypertrophy, or they remove more of the prostate than is required. The advantage that this operation has over removal of the prostate through a suprapubic opening alone is that it seems the best method for removing the side lobes of the prostate; and while these lobes may not be the causative factors in certain forms of reten-

tion of urine, still there is evidence to support the view that they are responsible for the varicose condition of the veins at the base of the bladder, which seems to aggravate that constant irritation almost always found in cases of prostatic hypertrophy. Following the operation a small projecting mass of tissue remains in the floor of the prostatic urethra, and care must be taken in introducing the perineal tube and packing not to bend it backward into the bladder.

REMOVAL OF THE PROSTATE THROUGH A SUPRAPUBIC OPENING

The subject of suprapubic cystotomy has been considered in connection with bladder surgery, and it is little more difficult to

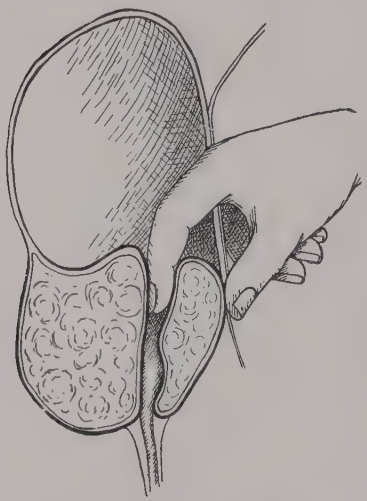


Fig. 265.—Fenwick's operation. Finger entering prostatic urethra (after Fenwick).

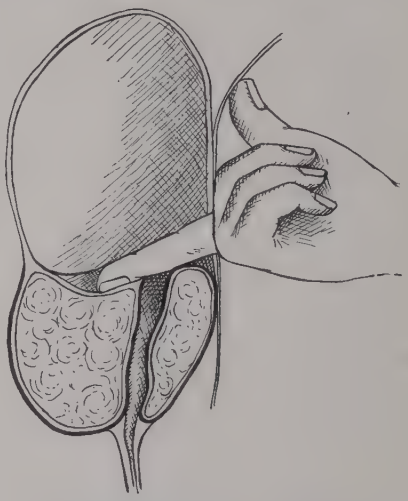


Fig. 266.—Fenwick's operation. Finger pushed sideways through wall of prostatic urethra (after Fenwick).

remove a third lobe of the prostate by means of a suprapubic cystotomy than it is to perform the operation of opening the bladder. The bladder having been opened and the interior carefully inspected, an incision may be made over any prostatic growth that may present itself, and the mass be dug out in much the same manner as in the operation just described. This manner of operating has many advocates, and in properly selected cases it may be considered the operation of choice. After the growth has

been dug out by the finger or pinched out by forceps, or teased out,

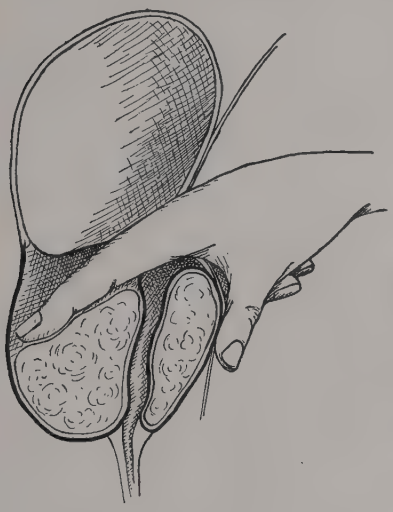


Fig. 267.—Fenwick's operation. Finger pushing between capsule and gland (after Fenwick).

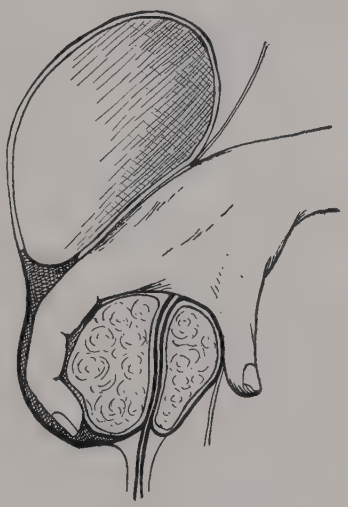


Fig. 268.—Fenwick's operation. Finger pushed still farther (after Fenwick).

a little at a time, the ordinary methods of checking hemorrhage should be employed, and a drainage-tube inserted in the bladder.

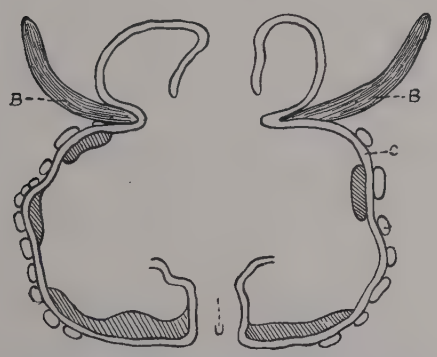


Fig. 269.—Prostatic capsule emptied of its contents with torn ends of prostatic urethra above and below. B, B, Bladder base; U, urethra; c, capsule (after Fenwick).

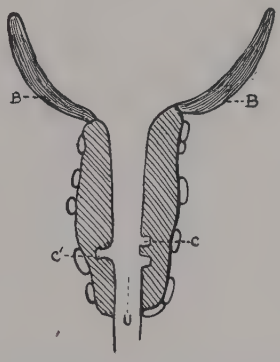


Fig. 270.—The same healed, ends lining shrunken prostatic capsule and fusing at c' c (after Fenwick).

If it seem desirable, an incision may be made in the perineum and perineal drainage established as well.

E. Hurry Fenwick, in a recent paper entitled "Vital Points in the Technic of Suprapubic Enucleation of the Prostate for Benign

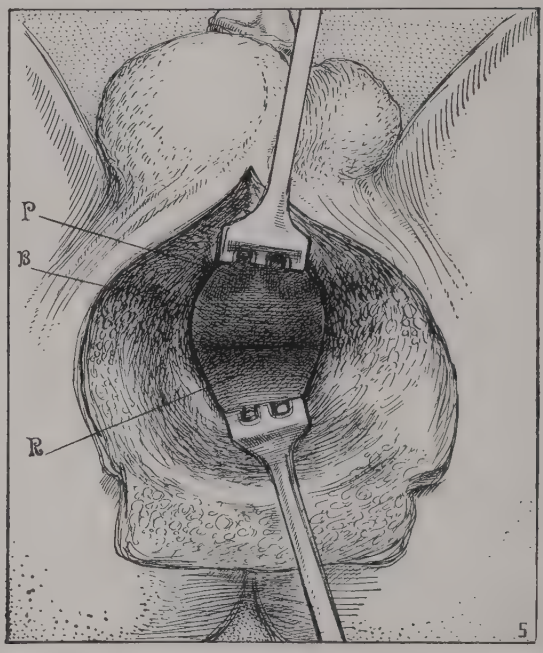


Fig. 271.—Relations of the prostate and the base of the bladder: P, Prostate; B, bladder; R, rectum.

Enlargement of that Gland," advocates the method of enucleating the lateral lobes of the prostate, which is similar to the Bryson method just detailed, with the exception that, as shown by his illustrations (figs. 265 to 270), he enucleates through the suprapubic opening. He claims that, by enucleating these lobes through breaking into the side walls of the prostatic urethra—(1) there is less danger of injuring the vesical neck; (2) the wholesale destruction of the prostatic urethra, with its afferent seminal ducts, is obviated; (3) the rough manipulations of the membranous urethra ordinarily accompanying the usual enucleation through the suprapubic route are rendered unnecessary. If a third lobe is present, it may be removed separately through an anterior or a posterior incision. He claims that enucleation of the prostate through the

suprapubic route as ordinarily carried out causes sterility, and is likely to give rise to the formation of a dense mass of cicatricial tissue at the neck of the bladder. His method is shown in the accompanying illustrations (Figs. 265 to 270). Dr. William T. Belfield, of Chicago, in 1887, was the first to report suprapubic operations on the prostate, followed by Mr. McGill, of Leeds, England, in 1888.

Dr. Eugene Fuller, of New York, was the first to extensively advocate a method for the removal of the entire prostate suprapubically; his method is practically that adopted by Dr. P. J. Freyer, about to be described.

Dr. P. J. Freyer describes in detail the manner in which he operates as follows[1]:

"A catheter having been introduced into the urethra and allowed to remain there, and the prostate being pushed up by the finger into the rectum, remove the prostate, scouring through the mucous membrane with the finger-nail, gradually detaching it by insinuating the finger-tip in succession behind, outside, and in front of one lateral lobe, this separating the capsule from the sheath. The finger is then swept in a circular fashion from without inward, in front of and to the inner side of the lobe, detaching this from the urethra, which is felt covering the catheter, and pushed forward toward the symphysis between the lateral lobes, which will, as a rule, have separated along their anterior commissure in the course of the manipulations. The other lobe is attached and treated in the same manner. The finger is next pushed well downward behind the prostate, and the inferior surface of the gland is peeled off the triangular ligament. When the prostate is felt free within its sheath and separated from the urethra, with the finger in the urethra, aided by that in the bladder, it is pushed into the bladder through the opening in the mucous membrane which, during the manipulations, will have become considerably enlarged. The prostate, which now lies free in the bladder, is withdrawn with strong forceps through the suprapubic wound."

He lays considerable stress on the use of a large drainage-

[1] "Clinical Lectures on the Enlargement of the Prostate," New York, 1906.

tube introduced just through suprapubic wound, but not allowed to strike the base of the bladder. Daily, through this tube, the bladder is gently irrigated. The tube is a large one, that the urine and clots may escape through it freely, and consequently there might be no straining in dilating the cavity or disturbance of the blood-clot which forms in the excavation. The

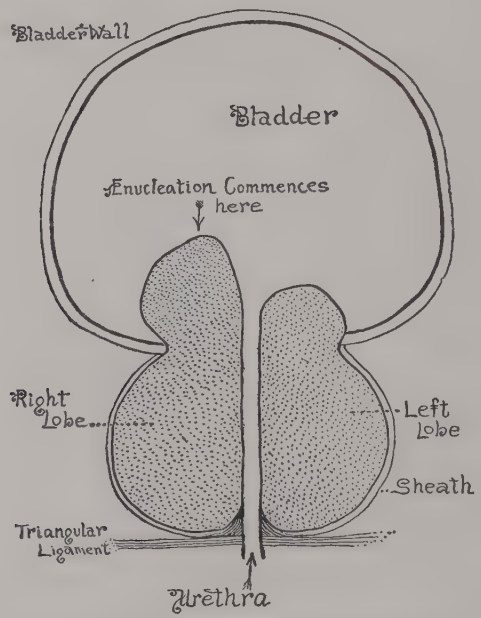


Fig. 272.—Suprapubic removal of the prostate (redrawn from P. J. Freyer).

tube should, as a rule, be removed at the end of four days, and the bladder irrigated by a nozzle placed in the suprapubic opening. In this operation the prostatic urethra is torn across, and some portion removed without apparently increasing the mortality.

It will be noticed that care is taken to avoid disturbing the blood-clot which forms in the excavation at the bottom of the wound by the use of this large drainage-tube. This really has a great deal to do with the low mortality rate which he reports. It is our belief, in these suprapubic operations and the Bryson operation, that it is septic absorption through the wound in the mucous membrane which is generally the cause of death. That is why we are inclined to think that the comparatively simple

procedure of the use of vaselin and iodoform in the Bryson operation, as mentioned above, the suggustion of Dr. H. E. Frazier, will be found of great benefit.

European surgeons advocate largely the use of the retention catheter for drainage purposes in these operations. The writers, after considerable experience with the instrument, cannot so recom-

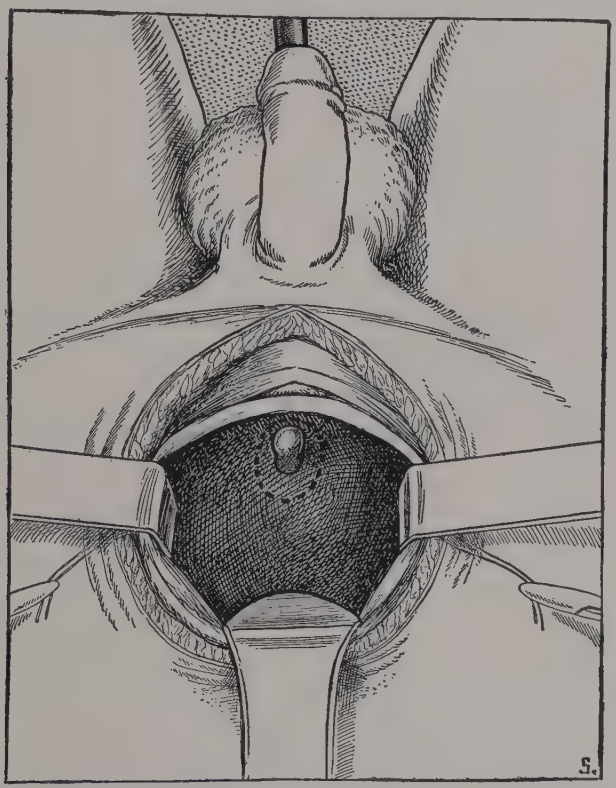


Fig. 273.—Suprapubic prostatectomy, showing usual place for incision in prostate (redrawn from Albarran).

mend it, for in a large number of cases its use has been followed by inflammation or ulceration, necessitating its discontinuance.

The after-treatment of the suprapubic operation for the relief of an enlarged prostate resembles that following suprapubic cystotomy for the removal of a stone or a tumor. Albarran has modified the suprapubic operation for the removal of the prostate in the manner described by Freyer to a slight extent. A sound

having been introduced into the bladder, and the suprapubic opening having been made, a circular incision with a bistoury is made around the neck, ordinarily as shown in the illustration. When at the bottom of the neck the projections of the median lobe constrains him from making an incision, he recommends raising it and incising the mucous membrane of the bladder back of the projecting part. When a sessile third lobe appears near the neck of the bladder he makes his incision on the most promi-

Fig. 274.—Vertical section, showing suprapubic method of enucleation of the prostate (redrawn from Albarran).

nent portion of it, always near the orifice of the urethra. He lays stress on making the pericervical incision of such a depth that the bistoury penetrates into the prostatic tissue. Ordinarily the incision is a centimeter in depth. His idea of a somewhat deep incision is that it makes it easier to find the plane of cleavage. He recommends that if the operator inserts his finger on one side and fails to find the plane of cleavage, he try the opening inside the other, and eventually failing to find the plane, should puncture the lateral lobes through the urethra, which is, according to the

method of Fenwick, as shown by the plates in the preceding pages.

One other modification suggested by Albarran seems deserving of attention, and that is his recommendation that the prostate, having been freed in all directions, should be dissected very carefully from the anterior wall of the urethra so as to preserve as much of the anterior wall of the urethra as possible, the posterior and side walls of the urethra in this operation having been necessarily

Fig. 275.—Showing cavity left after removal of prostate suprapubically (redrawn from Albarran).

torn across to a considerable extent. He recommends an incision with the bistoury of that portion of the anterior wall of the urethra that remains adhering to the otherwise freed prostate rather than tearing it violently across. His method is shown in the illustration. His suggestion as to using as much gentleness as possible in the removal of the prostate instead of making very violent and brutal efforts, seems worthy of special commendation, for the more of the membranous urethra is saved the less liability of incontinence of urine following the operation exists, and one great

danger of tearing out the prostate too violently, and especially where it adheres to the anterior wall of the urethra, is that of removing an unnecessary amount of the urethral wall.

In France it is a popular custom to remove the prostate through a half-moon incision, a speculum being used to depress the floor

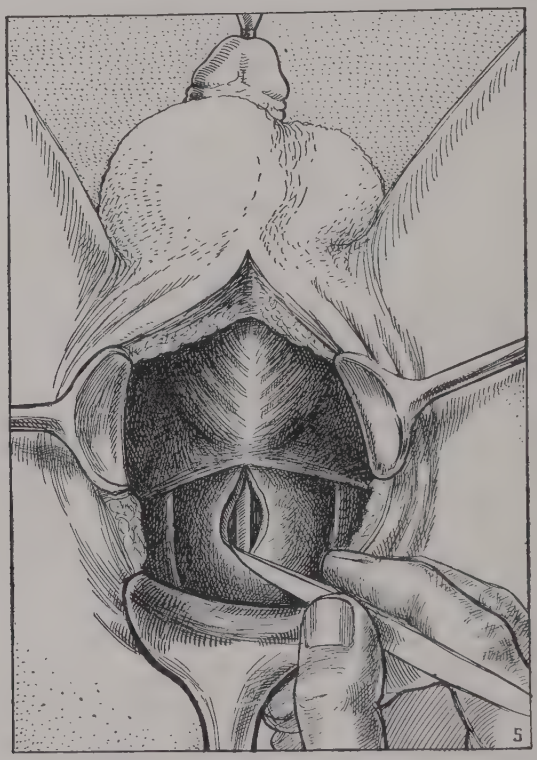


Fig. 276.—Removal of the prostate outside the capsule through straight perineal incision. The membranous urethra is opened on a grooved staff; the rectal tissues are pulled downward (after Deaver).

of the rectovesical space. The prostate being reached, the capsule is opened and turned back to each side like a cuff, the membranous urethra incised, then, with or without the use of a depressor, the side lobes removed, and the third lobe, if present, is removed by introducing a finger through the incision into the bladder, inverting the third lobe through the wound in the prostatic urethra and thus removing it. A retention catheter into bladder emerging through meatus; another drainage-tube into rectovesical space. This is practically the operation of Proust and Albarran.

In the operation of Hugh Young, of which a detailed description should be carefully studied,[1] a particular effort is made to save the integrity of the ejaculatory ducts. It is of the general character of the operations just described, an ingeniously devised prostatic tractor and several retractors lending aid to the ease of its performance, which can be accomplished very rapidly by one familiar with its technique. In order to get the patient into

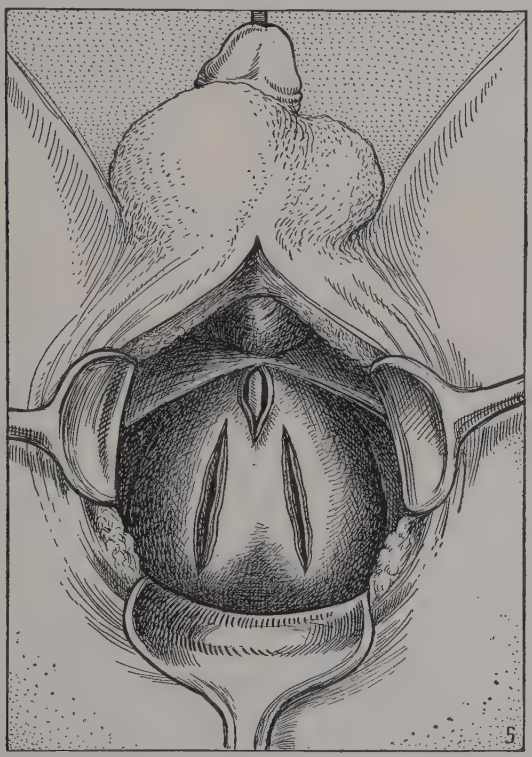


Fig. 277.—Removal of the prostate outside the capsule through straight perineal incision. By means of Fergusson's depressor the prostate is pulled well down into the perineum. The sheath of the prostate has been incised over each lateral lobe (after Deaver).

the proper position, so that room may be afforded for the use of the speculum to open up the rectovesical space, it is necessary to use an Albarran speculum or to place the patient on a box of certain shape, supporters for the legs of a certain form should also be used. These are illustrated in the following plates, and can be obtained through Tiemann & Co., New York. A

[1] "Keen's Surgery," Vol. IV., W. B. Saunders Company.

very popular operation, when it is desired to remove a prostate from outside the capsule and by the perineal route, is to make a long, straight, perineal incision; also incise the membranous urethra, and with a Fergusson depressor pull the prostate down into the perineal wound and then enucleate it, as shown in the illustrations (figs. 266 to 268). Speaking from a strictly surgical point of view, the operation, as performed in France, whereby the prostate

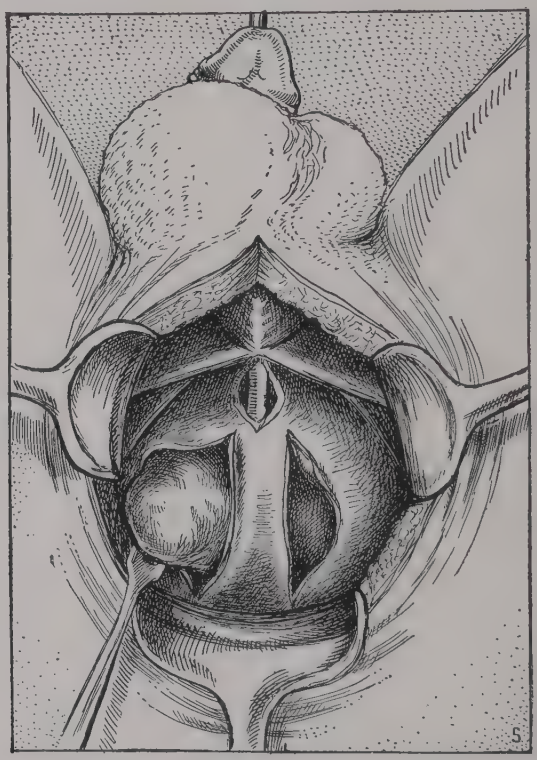


Fig. 278.—Removal of prostate outside the capsule through straight perineal incision. By blunt dissection and with the aid of Murphy's hooks as tractors each lateral lobe is removed in turn. Drain with tube in bladder or through the perineal wound, the tube being well packed (after Deaver).

is exposed through a semilunar incision through the perineum, and well brought into view through a proper-shaped speculum, by which the space is opened, is a useful one, from the fact that no excavation in the mucous membrane is left behind through which septic absorption can take place, as is the case when the suprapubic method is followed or the Bryson operation performed.

The operation just mentioned, however, unless the surgeon is familiar with the rectovesical space, is attended with danger of wounding the rectum, and for the inexpert takes longer than either the Bryson or the suprapubic operation to perform.

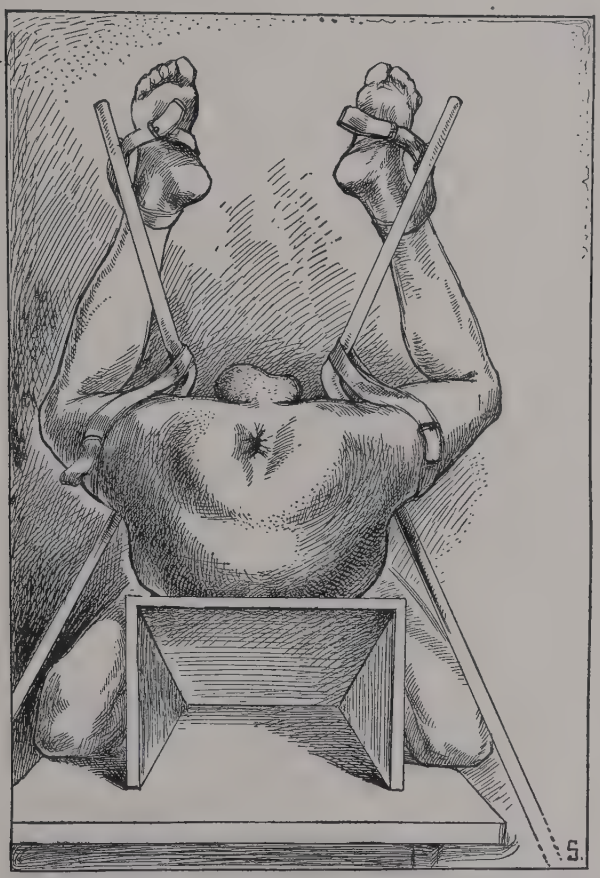


Fig. 279.—Illustrating leg supporters and position of patient for removal of prostate in Albarran and Proust's operation (redrawn from Pierre Duval).

The simple procedure mentioned before, of applying iodoform and vaselin after the Bryson operation, or the use of the large drainage-tube of Freyer, after the suprapubic, tends to obviate the danger of sepsis to a very marked degree.

From personal and contributed experience the writers are inclined to recommend the perineal route, performed in the man-

ner described under the name of the Bryson operation. Where, however, the enlargement is almost entirely of the third lobe; where there is but slight congestion due to varicose veins at the base of the bladder, and where the proper after-treatment of the suprapubic wound can be secured, the removal of this third lobe of the prostate by the suprapubic route may at times be advisable.

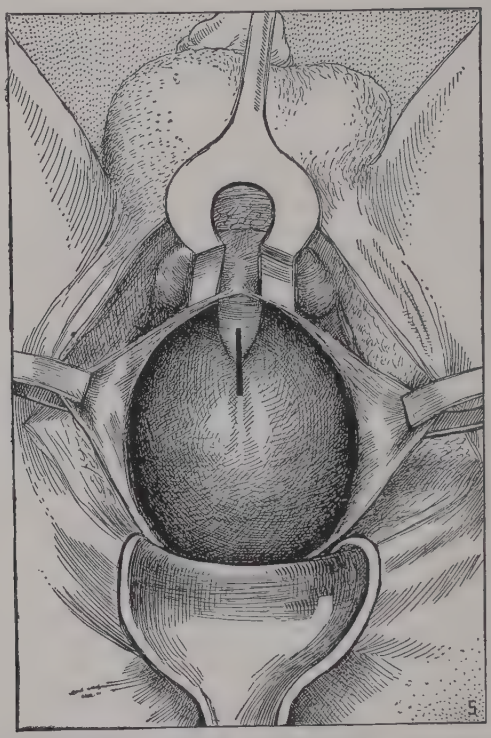


Fig. 280.—Illustrating the removal of prostate; incision through prostatic urethra. Speculum in position at base of figure. Method of Albarran and Proust (redrawn from Pierre Duval).

Partial Prostatectomy.—Criticism of the Bryson operation has been made that it does not remove the entire prostate. Judging from our experience up to the present time it is doubtful whether such criticism is founded on the proper understanding of the underlying conditions. While from a mechanical and purely surgical standpoint the total removal of the prostate may ordinarily be the object desired, from the standpoint of the patient and possibly from the physiologic standpoint an in-

complete removal may not infrequently furnish all the relief desired either through the removal of the lateral lobes through the Bryson operation, or suprapubically when a median lobe alone presents itself. It is interesting to note that to the best of our knowledge the fathers of suprapubic removal of the prostate, Dr. William T. Belfield, of Chicago, and, Mr. McGill, of Leeds, England, had this in mind in their first operations. This may again come into vogue, just as at the present time conservative operations on the ovaries are much more popular than was their complete removal a few years ago. As far as our personal observation is concerned a complete total enucleation of the prostate seems to have a more depressing effect on the nervous system of the individual following the operation than happens when some little prostatic tissue is left behind. In addition, the saving of as much as possible of the urethra renders the incontinence of urine less liable to occur. Whether or not any internal secretion of the prostate may play a part in conserving the general nerve tone of the individual is not a proper subject for discussion here, but the personal observation of the writers is as stated above.

TUMORS OF THE PROSTATE

Excluding prostatic hypertrophy, which the writers consider non-neoplastic and inflammatory in nature, tumors of the prostate gland occur less frequently than is generally believed. *Fibromata* of the prostate, which are commonly reported, usually occur as a result of inflammation and are but rarely true idiopathic neoplasms. *Myomata*, invariably of the smooth muscle type, are occasionally seen, but seldom grow to large size or have any clinical significance. *Sarcoma* of the prostate is rare, except when it occurs in the course of a general sarcomatosis. *Hypernephroma* of the prostate occurs as a somewhat rare metastatic growth, the writers having seen but two cases. Its recognition clinically is of but slight importance, however, since it appears only in hopeless conditions in which metastasis is general and beyond surgical relief. *Carcinoma* of the prostate gland is unquestionably the most frequent form of tumor, although prostatic cancer was formerly considered a very rare condition; Alberran and Halle were the first to recognize and report its frequency of occurrence. The

writers have found it most often in hypertrophied prostates, in which the interstitial hyperplasia and inflammatory exudate, with the resulting epithelial proliferation, frequently give rise to the development of cancerous growths in the enlarged gland, just as similar conditions also induce malignant disease in the mammary gland. Young, in a recent publication, finds cancerous alterations present in about 7 per cent. of his cases of prostatic hypertrophy, fully corroborating the statement previously made regarding its frequency. On account of the great clinical importance of prostatic cancer it has seemed best to discuss it fully under a separate heading.

Carcinoma of the Prostate.—In few, if any, of the organs of the body are the changes that transform a simple inflammatory process to a cancer more easily demonstrated than in the prostate. First, the simple inflammatory process obliterates the mouth of one of the acini of the prostate; epithelial cells are thrown off inside the acini and are unable to escape; the distention of the acini, as mentioned in connection with the pathology of prostatic hypertrophy, goes to make up, to a great extent, the various enlargements of the organ. Just so long as these cells remain inside the acini a simple inflammatory process is present; as soon as these cells break through the acini and invade the surrounding tissues cancer occurs. If one could tell what process causes these cells, at one time benign, to remain within the walls of the acini, and later on to wander under malignant impulses through the surrounding tissues, the problem as to the nature of cancer occurring in any portion of the body would be solved.

Cancer of the prostate was first recognized in 1817. At that time this growth, together with sarcoma and the ordinary so-called hypertrophy of the prostate, was considered under the head of cirrhus tumor; it is only during the past few years that a differentiation has been made between cancer and sarcoma of the prostate. Still more recently, as the result of the large number of sections made through prostates, cancer of small size has been found to occur—so small as occasionally to be confined to one lobe of the organ.

It is not easy, from statistics at present obtainable, to draw positive conclusions as to the frequency with which primary can-

cer of the prostate really appears; but, since the so-called hypertrophied prostate in the aged is a chronic inflammatory process, cancer may be expected to follow in a large proportion of such cases, just as it follows chronic inflammation attacking other glands of the body. Cancer of the prostate is being reported with

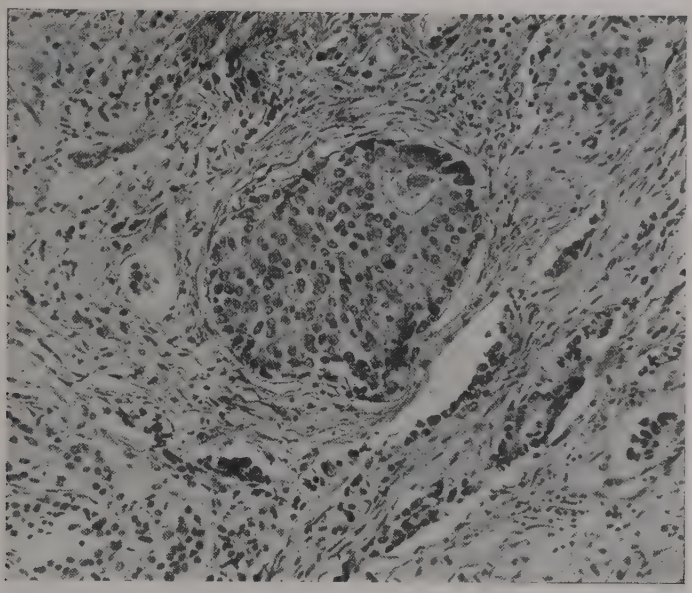


Fig. 281.—Microphotograph of cancer of the prostate.

increased frequency, and when it is remembered that a cancer may be so small as to be situated entirely within one lobe of the prostate, it may be seen how easily such growths may escape recognition. A case of very small cancer of the prostate was operated upon by one of the writers. Being confined to one lobe, it was discovered only after the prostate had been removed and sections made through it. It had been, nevertheless, the cause of much suffering, giving intense perineal pain. The prostate was otherwise comparatively healthy. Three years after the operation there was no indication of recurrence.

In a paper published by the writers,[1] the findings of a careful examination of fifty-eight enlarged prostates are set forth: in three of these cancer was present. The writers are convinced that

[1] Greene and Brooks: "Hypertrophy of the Prostate," 1903.

cancer of the prostate occurs in from 5 to 10 per cent. of old men suffering from prostatic hypertrophy, and, further, that occasionally cancers that are believed to occur primarily in other portions of the body, are really secondary to unrecognized prostatic carcinomata.

Glandular metastasis occurs in about nine-tenths of those cases of cancer of the prostate so far advanced as to be easily recognizable. About 30 per cent. exhibit inguinal gland enlargement, the axillary and subclavicular glands being those next most commonly affected.

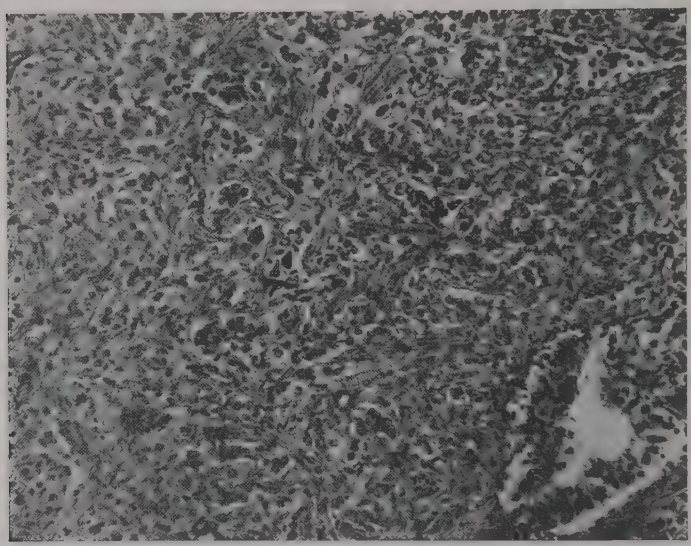


Fig. 282.—Microphotograph showing development of cancer in a sclerotic hypertrophied prostate.

Age.—It is difficult, from the literature on the subject, to state definitely the earliest age at which cancer of the prostate may occur. One case is recorded occurring in a man of thirty-eight; the average age, however, seems to be over fifty, and in one series of nineteen cases it was sixty-eight. In a large majority of the cases recorded a history of symptoms pointing toward prostatic disorders, of several years' standing, is generally given.

Cachexia.—This symptom has been strongly dwelt upon by most writers on the subject. It may be of diagnostic value in so far as

its comparatively sudden appearance in old prostatics, without other accountable reason, would naturally indicate that a malignant disease might be developing; or it might tend to increase the value of any other evidence pointing in that direction.

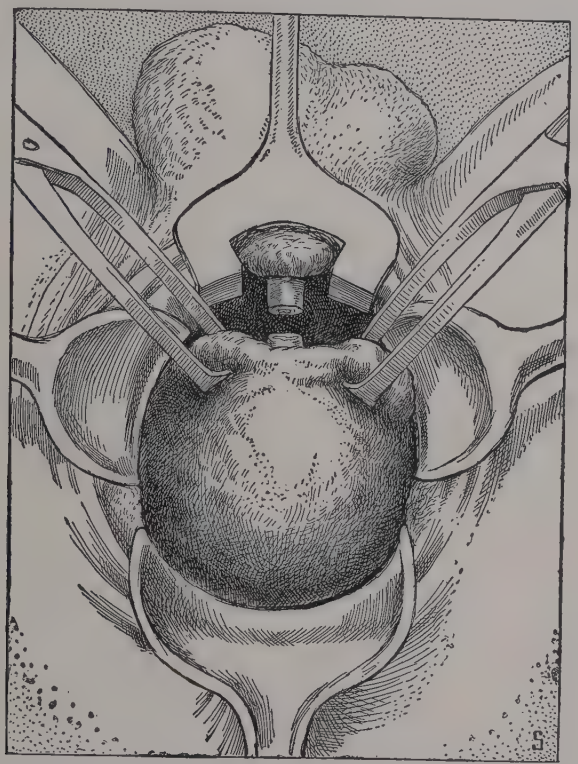


Fig. 283.—Total removal of prostate. Membranous urethra is incised (redrawn from Pierre Duval).

Pain.—Pain almost invariably accompanies cancer of the prostate, and may be the first symptom to awaken the suspicion of the existence of malignant disease. The pain may be referred to the prostate,—that is, to the perineal region,—to the rectum, to the back over the region of the kidney, to various portions traversed by branches of the sciatic nerve, to the region of the bladder, or to the glans penis. It may apparently arise directly from the prostate, or indirectly from the pressure of glands that may have become infected. As has been said, it may be the first symptom to give rise, in the mind of the observer, to the suspicion of malig-

nant disease, and as it may occur before metastasis into the neighboring lymphatics has taken place. Persistent pain occurring in an old prostatic, without other explanation to account for it, should ordinarily lead to early surgical intervention.

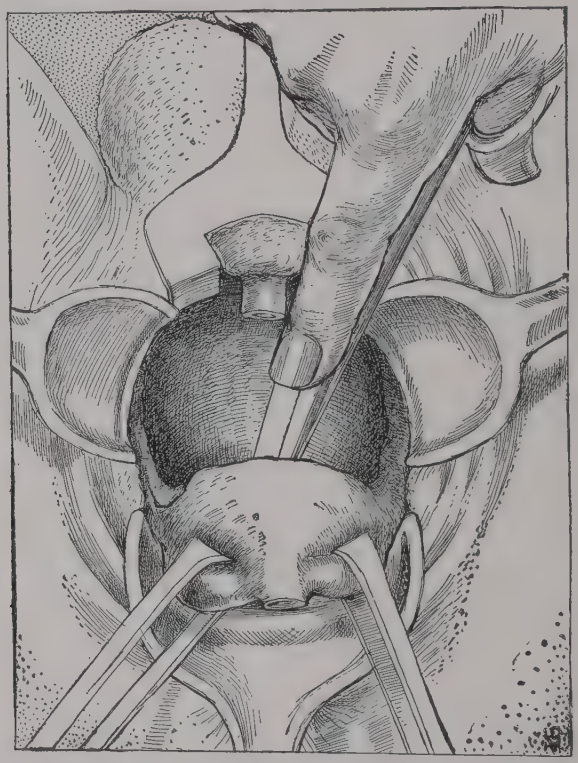


Fig. 284.—Total removal of prostate. Prostate being removed (redrawn from Pierre Duval).

Hematuria.—Next to pain, bloody urine, occurring perhaps in 50 per cent. of cases, is the most common symptom in cancer of the prostate. Careful use of the cystoscope will determine in any given case the cause of the bloody urine.

Physical Examination.—The amount of residual urine is of no particular diagnostic value. Cases of cancer of the prostate have been reported in which hardly any residual urine was present—in one case only a tablespoonful. This is not remarkable in view of the fact that cancer may occur without sufficiently increasing

the size of the prostate to cause marked obstruction to the urinary outflow. It must also be remarked that almost all these cases give a history of previous gonorrhea or injury.

The size and feel of the prostate, as ascertained by rectal touch or by urethral examination, are probably not in themselves of any great diagnostic value, except as a means of comparison.

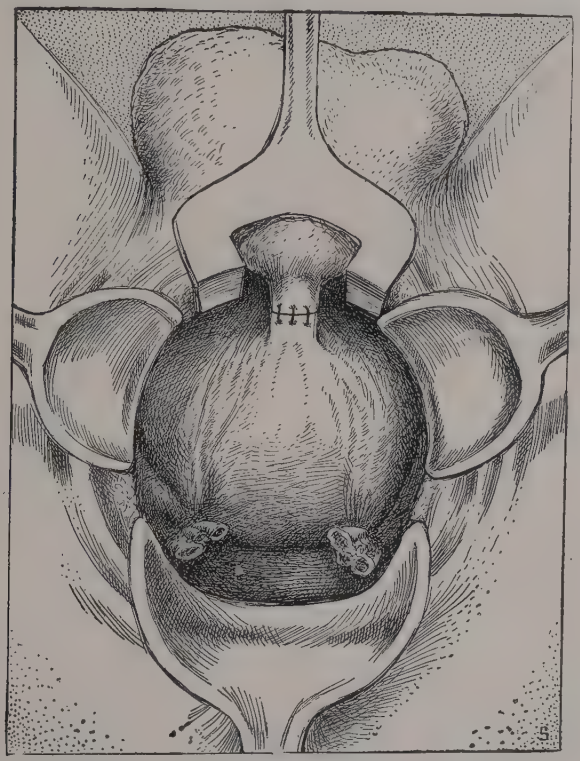


Fig. 285.—Total removal of prostate. Neck of bladder stitched to membranous urethra, prostate having been removed (redrawn from Pierre Duval).

These prostates may feel hard, nodular, or even soft. A sensation conveyed to the rectal touch as of a bunch in the prostate, or the feel of a cyst, the contents of which cannot be removed by massage of the gland, is considered by some as diagnostic of cancer. Examinations made to compare the size and consistency at different times may thus be of value. In an old prostatic whose gland has remained of about the same proportion for a long time, as determined by rectal or urethral examination, a sudden increase

in size is indicative of malignant disease or inflammatory exacerbation. Cancer of the prostate is more likely to arise in the lateral lobes or in one of them rather than in the so-called third lobe.

Prognosis.—In these cases the prognosis is, of course, grave, and where metastasis has begun, almost invariably fatal. The writers believe that if the diagnosis is made early enough, the cancer may be eradicated by surgical interference. Almost all the cases reported as having been operated upon have done badly so far as cure is concerned. In the writers' case, previously referred to, the recovery which took place after the operation was in all probability due to the fact that the prostate was removed before the cancer had time to cause glandular metastasis.

Treatment.—The treatment may be considered under three heads—preventive, palliative, and curative.

Preventive.—The ultimate analysis of the question of preventive treatment seems to lead to the conclusion that if gonorrhea or any urethral inflammatory process could be prevented in the first place, cancer of the prostate would become much less frequent, for it is now well established that chronic posterior urethritis is a very frequent complication of acute urethritis. More and more evidence is being brought out to demonstrate that chronic posterior urethritis and chronic prostatitis go hand in hand; that the latter plays a causative rôle in the formation of the so-called prostatic hypertrophy, and that this in turn, reasoning from analogy, plays a part in the formation of cancer. It would seem also that more prolonged and careful treatment of chronic posterior urethritis and prostatitis would tend to prevent the so-called hypertrophy and, secondarily thereto, the cancer.

Palliative.—From the literature on the subject it will be seen that in most recorded cases of cancer of the prostate the diagnosis has been made only after metastasis had taken place and general systemic infection occurred. Consequently the operations attempted in the hope of effecting a cure have proved failures. Something may be said, however, in favor of operations performed for the purpose of prolonging life, or, more particularly in the later stages of the disease, for the relief of symptoms, especially pain. From the writers' experience with palliative operations in tuberculosis and cancer occurring in other portions of the genito-

urinary tract, they conclude that such operations are justifiable in prostatic carcinoma, but they believe that they should not be attempted if they are likely to make the progress of the disease more distressing to the patient.

Curative.—So far, the only curative procedure known consists in removing the cancerous prostate before metastasis has taken place. Now that this condition is receiving more attention, it is to be hoped that an earlier recognition will result in the recovery of a larger number of patients.

In certain forms of cancer of the prostate total extirpation of the prostate, with amputation of the prostatic urethra, as illustrated in the method of Proust (figs. 283, 284, and 285), may be found necessary.

CHAPTER XXVIII

THE TESTICLE AND EPIDIDYMIS

ANATOMY

The testicle is a compound tubular gland of complicated structure. It produces a secretion, the spermatozoa, which form the essential of the seminal discharge.

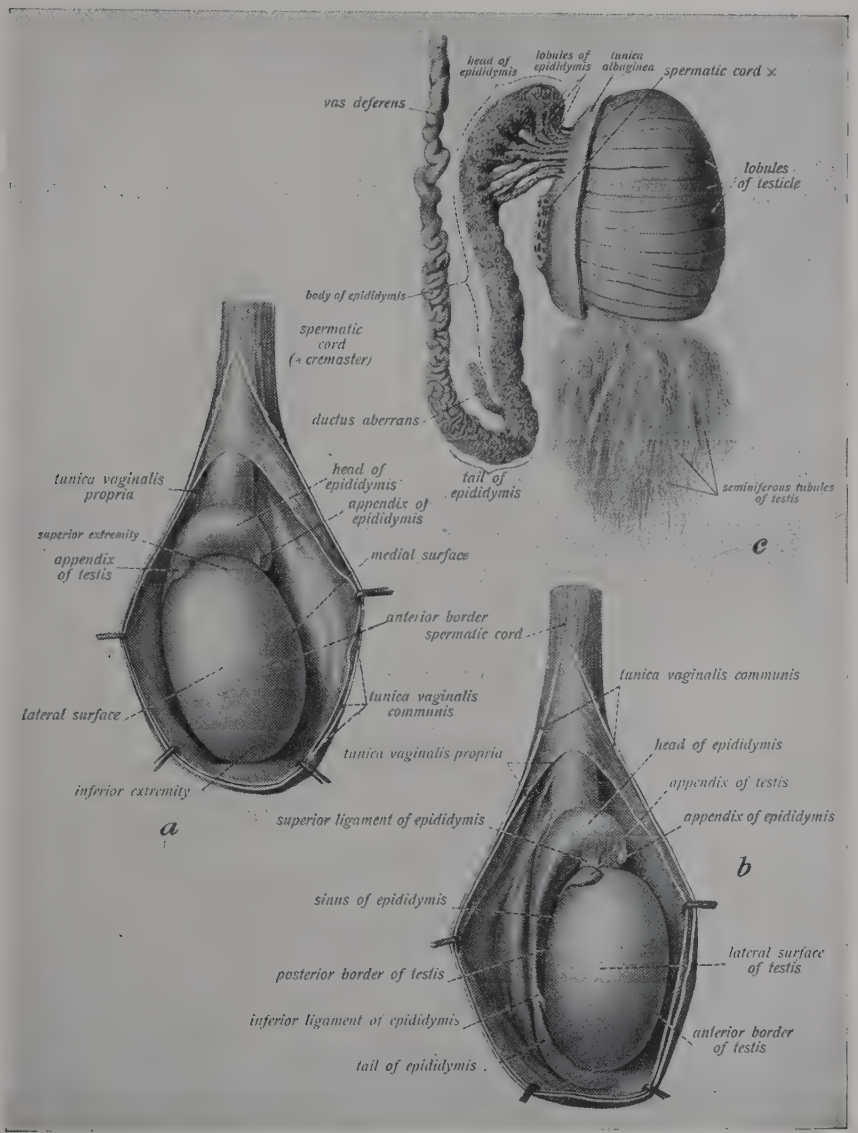
The testicle is invested by a reflection of the peritoneum. This gives it its outer or serofibrous coat, which is not applied close to the surface of the organ, but is derived as it passes from the abdominal cavity into the scrotum; this is known as the *tunica vaginalis*.

The gland is inclosed and limited by a strong, thick capsule called the *tunica albuginea*. This is a dense, unyielding membrane of white color; it is composed of compact bundles of white fibrous tissue that interlace in various directions. Its inner layer is richly supplied with blood-vessels and is sometimes called the *tunica vasculosa*.

In the interior, fibers from the tunica albuginea are prolonged from the posterior border for a short distance into the gland, so as to form the complete vertical septum called the *corpus highmorianum*, or the *mediastinum testis*. This septum contains the larger blood-vessels of the gland.

From the front and sides of the mediastinum are given off numerous slender fibrous cords and imperfect connective-tissue septa that radiate from the mediastinum toward the opposite wall of the albuginea, with which the ends of the septa blend. In this manner the gland is divided off into from 100 to 200 more or less imperfect lobes. The septa, although made up of connective tissue, also contain a few smooth muscle-fibers and transmit branches of the mediastinal arteries to all parts of the gland structure. They also inclose certain large connective-tissue cells, the cytoplasm of which is rich in metaplasm.

PLATE XVIII



a, The testis and epididymis with their investing membranes seen from in front, *b*, seen from the lateral surface; *c*, the testis, epididymis, and the proximal portion of the vas deferens. The tunica albuginea has been completely removed from the epididymis and partly from the testis; the tubuli contorti of the lowest lobule of the testis have been isolated (Sobotta and McMurrich).

The glandular or secreting portion of the testis is inclosed and supported by this connective-tissue framework just described, made up of the tunica albuginea, the mediastinum, and the septa. The glandular portion consists of the *seminiferous tubules* and of their excretory ducts. Each compartment or lobe contains two, three, or more tubules, all of which extend out from the mediastinum in a comparatively straight course, but become greatly convoluted and entwined about one another as they extend toward the periphery. The length of the individual tubule varies somewhat when straightened out—some of them are found to be as much as twenty inches long.

The seminiferous tubules may be divided into three portions—the *convoluted tubules*, the loops of which make up the bulk of the lobe; the *straight tubules*, which are the terminations of the convoluted tubules and are found at the apex of the lobule; and the tubules into which the straight tubes empty, and which are seen in the mediastinum; these make up the *rete testis*.

The seminiferous tubules are lined throughout with epithelium, which varies in different portions of the tubule and presents, in parts, a complicated arrangement. In all portions the epithelium is laid down on a basement membrane composed of several layers of flattened endothelioid connective-tissue cells; outside this cellular layer a fibrillar membrane is found.

The active secretory function of the tubule takes place in the convoluted portions, and it is here that we find the epithelium taking on its most complicated arrangement and form.

In the convoluted tubules three varieties of epithelial cells are found: first, the cells arranged on the basement membrane, named the *spermatogonia;* next, a layer of cells, often two or three deep, called the *spermatocytes*, and, finally, the innermost of all, the *spermatids*.

The spermatogonia are of two varieties: first, and most numerous, the irregular polygonal or oval cells whose nuclei are rich in chromatin; between these, at irregular intervals, are seen certain tall, thin cells that project upward nearly into the lumen of the tubule, and are called the *columns of Sertoli* or the *sustentacular cells*. These take no active part in the formation of the spermatozoa, but only support the polygonal cells so closely

crowded around them, from which the spermatozoa develop. This development takes place from the rapid division of the polygonal cells, after an interval of rest, these primary spermatocytes, grouped about the columns of Sertoli divide again, so that, finally, each primary spermatocyte is doubled; next each spermatocyte divides into two spermatids, each of which incloses a centrosome and is very rich in chromatin derived from the original nucleus. Cytoplasm is somewhat scanty in the spermatids.

From the spermatids are developed the spermatozoa, but the manner in which this development takes place is still an undecided question. At any rate, the chromatin of the spermatids cleaves, and from the resulting stages the spermatozoa are formed from the chromatin. Some believe that the entire spermatozoon is derived from the chromatin, whereas others hold that only the head and body are so formed, the tail being derived from the cytoplasm.

Spermatogenesis does not take place in every part of the testicle at the same time. Some tubules are in a quiescent or resting stage, while others carry on the secretory function; then the active cells pass to a resting stage, and the recuperated ones take up the active function.

The straight tubules are much smaller than the convoluted tubules, and are lined by a single layer of low columnar or cuboid cells.

In the rete testis the tubules, now excretory ducts, vary much in size and shape—from narrow clefts and channels to large open tubules; they are lined by a single layer of flattened epithelial plates.

The tubules of the rete testis coalesce to form about ten or twelve tubules called the *vasa efferentia*, which emerge from the limitations of the testis and are thrown into numerous folds, making up the *globus major* or the *head of the epididymis*. The tubes are lined by a simple or stratified columnar epithelium which is covered with long cilia which, in the fresh condition, wave away from the testis. This epithelium is arranged on a thick, fibrous wall in which are included some smooth muscle-fibers.

The *body* and *tail of the epididymis* are made up of the convolutions of the tubules, which in turn are a continuation of those which make up the globus major; and this is continued as the

spermatic duct or the *vas deferens*, which is a tubule about 20 inches in length, extending from the epididymis to the root of the penis. The walls of the vas deferens are made up, first, of an internal coat of ciliated epithelium laid down on a somewhat thick basement membrane, beneath which is a quite thin layer of areolar connective tissue, followed by an inner circular and an outer longitudinal coat of smooth muscle.

The vas deferens passes through the prostate gland to the neck of the bladder, where it presents on each side an ampulla or dilatation that empties through the ejaculatory duct into the urethra.

Blood and Nerve Supply.—The testicles and epididymis are nourished by the spermatic arteries, which arise directly from the aorta. The veins of both testicle and epididymis unite as they ascend along the cord, about which an intimate venous anastomosis, known as the pampiniform plexus, is formed. The nerves are derived from the sympathetic system and the spermatic plexus is connected with the renal and aortic plexuses.

The *lymphatics* follow the general course of the blood-vessels and drain into the lumbar lymph-nodes.

THE PATHOLOGY OF DISEASES OF THE TESTICLE

Defects.—*Complete absence of the testicles* is occasionally met as a congenital defect, being usually associated also with absence of the epididymis, vas, and seminal vesicles. The absence of a single testicle, the result of some defect of development, is relatively a common occurrence, but is usually due to some disease of the nutrient arteries in the early stages of development; such being the case, it is not uncommonly seen when both vas and epididymis of the same side are present.

Cases of *supernumerary testicle* are occasionally reported, but a microscopic examination demonstrates that in most cases the supernumerary bodies are not true testicles. Such conditions ordinarily give rise to no symptoms. The differential diagnosis must generally be made from hydrocele and hernia.

Micro-orchia or hypoplasia of one or both testicles is a relatively frequent condition. As a rule, it is associated with other defects of development, although it is occasionally seen in otherwise normal persons. As a rule, when both organs are involved,

the body shows lack of sexual development, the general type of an asexual individual pertaining. In nearly all instances the organs represent delayed development, and are found in a stage representing early formation. Spermatogenesis does not take place, and, in so far as its influence on the body as a whole is concerned, the testicle may be considered as practically absent.

Monorchidism or *cryptorchidism* is the condition in which one or both organs are retained in the abdominal cavity, in the external or internal ring, or in the inguinal canal, and fail to pass into the scrotum. The condition depends upon prenatal disease, such as abnormal closure of, or a small inguinal canal, a short gubernaculum, or adhesions to the abdominal or pelvic viscera. Under such conditions the organs are not infrequently more or less hypoplastic, although in many cases of double cryptorchidism function may be perfect. Spermatogenesis, however, is, as a rule, considerably below the normal in these cases.

When the organ is so markedly misplaced as to cause discomfort, or where a tendency to the formation of hernia exists, surgical intervention is occasionally desirable. Under other circumstances, however, except in youth, normal placement of the organ is usually unnecessary, except when done for cosmetic purposes, and little is to be expected in the way of increased functional ability.

Ordinarily such conditions give rise to no symptoms. If a testicle is retained in the abdomen, the differentiation from congenital absence of a testicle is attended with difficulty, and apparently but little can be done in either instance; if retained in the inguinal canal, it is ordinarily easy to feel and recognize. It is believed by some that retained testicles have a tendency to become malignant. The treatment of the condition is either negative or surgical.

Hypertrophy of the testicle is a rare condition, except where it occurs as a compensatory process in cases of monolateral congenital hypoplasia or disease in early youth. When the condition occurs, it takes place by enlargement of the spermatic tubules; it is very questionable if the true formation of new tubules ever takes place.

Atrophy of the testicle appears most frequently as a result of chronic inflammatory disease in which necrosis or loss of substance

has taken place, with subsequent interstitial hyperplasia and a normal retraction that takes place in scar formation. Atrophy may also occur in marasmus, extreme old age, and in general nutritive disorders of pronounced degree. Endarteritis and sclerosis involving the nutrient arteries of the organ may also cause atrophy. Pressure on the spermatic artery, as from an improperly fitting truss, may occasionally cause atrophy.

The diagnosis of a marked degree of atrophy is simple; when the atrophy is not extreme, it is somewhat more difficult. Marked atrophy is generally associated with loss of the sexual functions. The treatment would necessarily consist in the treatment of causa-

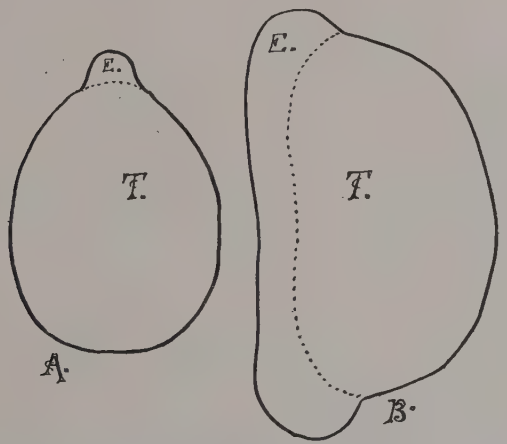


Fig. 286.—Showing the relations of the testis and epididymis in acute orchitis. T, T, Testis; E, E, epididymis; A, sagittal section; B, horizontal section (Kocher).

tive conditions, together with such local measures as may be most practical in the particular instance.

Fatty metamorphosis of the testicle is occasionally seen. In this condition the entire parenchymatous tissue may be replaced by masses of adipose tissue or fat; it is usually seen in extreme old age or in long-standing wasting diseases, such as chronic tuberculosis or syphilis.

A diagnosis is not usually easily made. It may sometimes be suspected in men who exhibit an excessive amount of adipose tissue combined with marked loss of sexual power.

Acute Orchitis.—*Etiology.*—Acute orchitis occurs most fre-

quently from direct infection of the testicular substance by the infectious processes of the epididymis, vas deferens, or seminal vesicles. It is, therefore, usually seen as an accompaniment or sequence of urethritis of various types. True orchitis is much less frequent than is generally believed, the condition being often confounded with epididymitis.

It may also arise in certain specific types of general disease with local testicular manifestations. This is particularly well demonstrated in mumps, typhoid fever, and variola.

Pathologic Anatomy.—Acute orchitis is usually manifested by the occurrence of edema, hyperemia, and swelling of the interstitial tissues of the organs, with resulting compression, degeneration, and desquamation of the parenchymatous epithelium. The hyperemia may pass on to a true hyperemic extravasation, or the leukocytic infiltration may become associated with necrosis and eventually with suppuration. In the mild inflammations recovery takes place by absorption of the inflammatory exudate, and the degenerated epithelium is replaced by hyperplasia of the normal remaining cells of the spermatic tubules. When absorption is incomplete, or in those cases in which loss of substance has taken place, interstitial hyperplasia occurs, oftentimes resulting in tubular atrophy, and the process may become transformed in this manner into one of chronic orchitis.

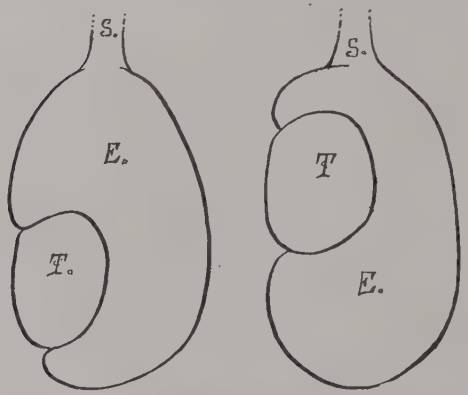


Fig. 287.—Illustrating the relations of the epididymis and testis in acute epididymitis. In the first figure the head of the epididymis is chiefly affected and in the second figure the tail. T, T, Testis; E, E, epididymis; S, S, spermatic cord (Kocher).

The **symptoms** of acute orchitis are swelling of the testicle, pain in the scrotum and loins, and general systemic disturbances. It is often associated with acute urethritis, following injury, and also with tuberculosis and syphilis, although the type presented

in the two last-named conditions is somewhat different from acute orchitis as ordinarily seen. Under ordinary circumstances, within two or three weeks after its onset, resolution tends to take place and the swelling subsides. It must be differentiated from epididymitis, neoplasms, hernia, and hydrocele. It is not infrequently associated with acute epididymitis, and the diagnosis may be reached by manipulating the swollen mass, making out the lines of demarcation between the epididymis and the tes-

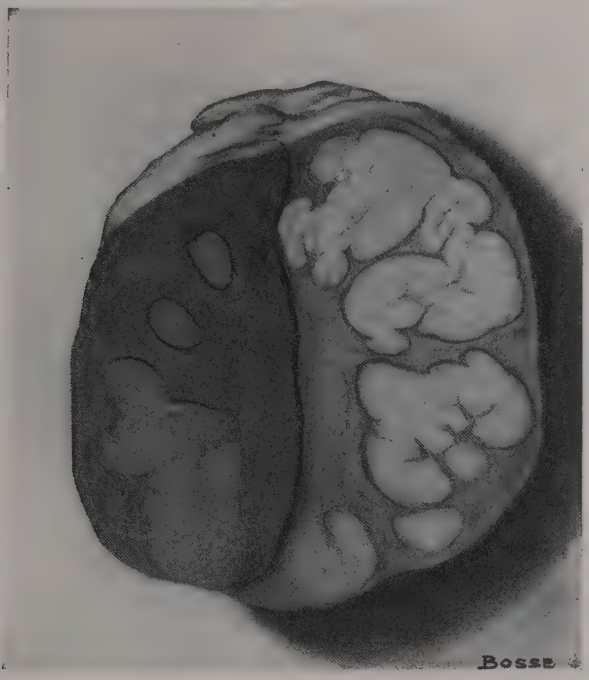


Fig. 288.—Tubercular orchitis (natural size). From a specimen in the Museum of Carnegie Laboratory.

ticle, and finding the body of the testicle proper swollen and tender on pressure. When not associated with acute epididymitis, it is comparatively easy to make out the line of demarcation between the epididymis by its normal shape, and the inflamed, enlarged, and tender testicle.

Chronic orchitis usually follows as a direct sequence of the acute type of the disease. It may also occur in chronic arterial affections. In either case it is characterized by proliferation and

thickening of the interstitium, with atrophy of the tubular elements. If the disease progresses, the organ becomes very small and hard, and is frequently the seat of various forms of infiltration, particularly the calcareous variety. Ordinarily there are no distinctive symptoms associated with chronic orchitis, and it is sometimes difficult to diagnose from similar conditions due to tuberculosis or at times from new-growths. It may occur as a complication of mumps, and is believed to be due at times to rheumatism or malaria, although no cases have come under the writers' observation in which this could be definitely demonstrated.

Tubercular Orchitis.—Tubercular orchitis has its origin, as a rule, in tubercular epididymitis. In a considerable number of cases it appears to follow simple epididymitis as a secondary process. It apparently occurs in many cases as a primary process in the epididymis, the infection having apparently been derived through the lymphatics or the vas deferens. Infection by the blood-vessels probably also occasionally occurs. In some cases the disease has followed direct traumatism to the testicle. In these instances the process probably develops in the *locus minora resistentia*, very likely from organisms derived from a quiescent and perhaps unrecognized lymphatic lesion.

As a rule, the tubercle formation is associated with active growth on the part of the connective tissue, oftentimes with pus-formation and extensive necrosis. The process is generally quite active, and is not infrequently followed by general lymphatic involvement, and particularly by a general miliary tuberculosis. Active caseation is the rule, and in relatively long-standing cases calcareous infiltration occurs. In almost all instances of tubercular orchitis the process eventually extends out into the tunica vaginalis and involves the scrotum proper, causing induration and ulceration of the skin. Tubercular orchitis may be found associated with neoplasms. One of the authors has been recently shown a case of this nature by Dr. Theodore Kuhne. The primary lesion was a tubercular orchitis following a blow on the gland received while playing foot-ball. Shortly after the injury rapid isolated growth took place at the site of the trauma, and the nature of the mass was most puzzling clinically. Microscopic

examination showed tuberculosis, with the necrosed area infiltrated by spindle-cell sarcoma. The subsequent history of this case showed the sarcoma to have originated in the kidney, with early metastasis in the testis.

The *symptoms* of tubercular orchitis are ordinarily pain, swelling, and ulceration. In some cases no manifestations may be present except the presence of tumor in the testicle proper or in the epididymis. When necrosis takes place, superficial ulcerations form. The disease must be differentiated from gumma, malignant disease, and the after-result of simple orchitis following injury or gonorrheal or other infectious processes. Under ordinary circumstances, the general systemic manifestations of tuberculosis are present and tend to make the diagnosis clear. The condition is sometimes associated with a slight, brownish-yellow discharge from the urethra. The occasional presence of tubercle bacilli in such discharge confirms the diagnosis.

Syphilitic Orchitis.—The testicle frequently becomes the seat of gummata in tertiary syphilis, and not uncommonly may be so diffusely involved as to present a close gross resemblance to tubercular orchitis. In secondary syphilis intertubular areas of small round-cell infiltration, often with more or less caseation, are seen.

Symptoms.—Ordinarily, beyond the enlargement, orchitis due to syphilis does not present many symptoms. Breaking down or gumma leads to ulcerations, which may be mistaken for tubercular ulcerations or those due to malignant disease. In such instances the diagnosis is aided by observing the effect of a vigorous course of specific medication. It is very difficult, by means of a physical examination alone, to differentiate between a tubercular infiltration into the testicle and an infiltration due to small gummata. Gumma in its most frequent form is very commonly confused with new-growths, and no case of tumor or ulcerating inflammation of the testes should be operated upon until antisyphilitic treatment has been tried. Numerous cases have, in the experience of the authors, impressively illustrated the wisdom of this step.

Epididymitis.—This is an inflammatory condition of the epididymis, and on account of the great mass of blood-vessels entering into this structure, is prone to be very active in its manifestations. It may be divided into two forms—acute and chronic.

Acute epididymitis is ordinarily due to extension of the inflammation from an acute urethritis from the posterior urethra to the vasa deferentia and to the epididymis, which becomes swollen and painful. This condition may affect one or both epididymes, and may develop at any time in the course of acute urethritis. Ordinarily it may run a course of two or three weeks' duration, reaching its height generally at the end of the second week.

Symptoms and Diagnosis.—Within two or three days after the onset of the first symptoms, swelling, pain, and general systemic discomfort develop. The pain extends upward along the course of the cord into the groin, and occasionally into the abdomen. The pain may be very intense in character and associated with general malaise. In the majority of cases a slight rise in temperature occurs.

The differential diagnosis from acute orchitis has previously been mentioned. In acute epididymitis not associated with acute orchitis the body of the testicle proper can be made out; it is normal in size and not tender on pressure, whereas the swollen epididymis is extremely painful. In acute epididymitis the cord is also swollen to some extent. Ordinarily, at the end of from two to three weeks, the acute symptoms have disappeared, and more or less resolution has taken place. Nodules of inflammatory infiltration are often left behind, absorb very slowly, or frequently exist throughout life. Acute epididymitis is a common cause of sterility, the inflammatory products obstructing the canal of the vas deferens or causing some change either in its expulsive power or in the character of the secretion. Occasionally, after an attack of acute epididymitis, while undergoing resolution, relapses occur. These relapses are, as a rule, more painful and associated with greater systemic disturbance than accompanied the original attack.

Chronic epididymitis may be diagnosed only with difficulty on physical examination, although, under ordinary circumstances, some nodules of thickening may be detected either at the head or at the tail of the epididymis. A history of a previous acute attack of epididymitis is also given. The inflammatory products that are present in chronic epididymitis not infrequently serve as a

nidus or predisposing agent for the development of tubercular disease of the epididymis or testicle.

As showing the necessity for the thorough and prolonged treatment of chronic epididymitis, so careful an observer as Casper makes the following statement: "I can state that the majority of childless marriages in which the husband is at fault had depended upon a double epididymitis. It always leaves nodules behind, also predisposes to tuberculosis."

Torsion of the Cord.—This is a condition in which the cord is twisted. It is seen more often with a retained testicle, but occasionally with one which has descended. As a result of some violent muscular effort, the testicle becomes displaced and a condition resembling an acute orchiepididymitis ensues. The *diagnosis* can generally be made from the history of the case, and when the inflammatory condition admits, from the discovery of the lesion on physical examination. The condition is very rare.

Treatment.—Cases should be carefully observed, and if the inflammatory process continues after simple measures have been used, early incision is advisable, cleaning out of the clots, straightening, if possible, the cord, thus attempting to save the testicle. This failing, testicle should be removed in the manner described in the following chapter.

Much more frequent, though still rare, is a condition of orchiepididymitis due to *strain* set up through violent muscular effort, in which the cord has apparently been wrenched, but the testicle not displaced.

One of us has had under his care three cases of this character, and have considered them as due to a wrench of the cord. White and Martin[1] have in their work written most exhaustively and interestingly on this and allied conditions. They have observed twelve cases, and consider it due to one of three causes: First, contracture of the cremaster muscle; second, from rupture of the veins; and third, from marked lesions, and they mention under this heading, infection passing from posterior urethra along the vas. The *prognosis* should be guarded. In one of the cases occurring in the practice of one of us it was finally necessary to remove the testicle. The *treatment* is similar to that of torsion of the cord.

[1] "Genito-urinary Diseases and Syphilis," Phila., 1906.

Spermatoceles are retention cysts of the testicle or epididymis, the contents of which are spermatic fluid. They are ordinarily of slow growth, have the appearance and characteristics of cysts, and sometimes cause pain if congestion of the organs exists. They may be congenital or may be due to trauma. Although not infrequently reported, judging from our clinical and pathologic experience, such cysts are quite unusual.

Treatment.—Enucleation of the sac.

Tumors of the Testicle.—According to some authors, tumors of the testicle are rare; in the writers' experience, however, they are not uncommon. Not infrequently they are confused with various forms of orchitis, notably with the tubercular and syphilitic varieties. Even after removal of the tumors their gross appearance is very often misinterpreted by surgeons of wide experience. It is, therefore, essential that a microscopic examination of the tissues be made before an absolute differential diagnosis is made between new-growths of the testicle and orchitis—particularly the tubercular, syphilitic, or actinomycotic forms. Fortunately, the treatment in all cases, with the exception of the syphilitic, is practically the same; and clinically a course of mercury and the iodids is prescribed as a matter of routine in most cases of testicular growth before operative measures are adopted. In many cases, particularly when erosion of the scrotum has taken place, material may be conveniently secured for microscopic examination, and this should be done whenever possible. The writers do not, however, advocate the practice of cutting through the intact scrotum into a tumor of the testicle for the sole purpose of securing material for microscopic examination, for they believe that in a certain number of cases this procedure tends to favor dissemination and the early production of metastases. On the other hand, particularly when both testicles are involved, it is excellent practice to prepare the case for operation,—that is, for castration,—and, in the course of the operation, to select and remove a segment of tissue, submitting it to immediate examination by the frozen section method, so that the proper treatment may at once be decided on and dangerous delays avoided. The writers have seen several cases in which serious errors resulted from the disregard of this simple precaution.

Tumors of the testicle, excluding, of course, those of purely inflammatory origin, may be conveniently divided into three classes: the cystic, the benign, and the malignant.

Cystic Tumors of the Testicle.—Retention cysts of the testicle usually occur as the result of localized areas of inflammatory disease that cause occlusion of one or more of the excretory tubules, either in the body of the testicle or, more frequently, in the rete or tubuli efferenti. Cysts thus formed commonly contain a more or less turbid, milky fluid, in which the presence of spermatozoa and broken-down epithelial cells may be demonstrated. Occasionally, particularly in long-standing cases, the cysts may contain a clear serum, and be separated from the surrounding structures by well-defined capsules of connective tissue. In a certain number of cases these retention cysts may be multiple and may closely simulate colloid carcinoma or other forms of malignant disease.

Papillomatous adenocystomata are benign growths involving the testicle somewhat rarely, and characterized by the formation of cystic cavities lined by columnar epithelium, which, being in an active state of proliferation, may grow into the cavity of the cysts, eventually filling them with friable masses of proliferating cells. These tumors possess, in general, many of the characteristics of the papillary adenocystoma of the ovary, and, like these growths, are prone eventually to become malignant and to set up metastases, particularly by direct transmission. It seems probable that these cystic tumors may eventuate from the retention cysts previously described, or perhaps from persistent remnants of Müller's canal.

Dermoid cysts of the testicle are rare, and are relatively very much less frequent than a similar growth found rather commonly in the ovary. As a rule, gross examination is all that is required for their identification.

Parasitic cystic tumors of the testicle are very rare in this country, although one occasionally encounters echinococcus cysts of the testicle, most often, however, in foreigners, and even then with great infrequency.

Benign Tumors of the Testicle.—The benign tumors of the testicle are fibroma, chondroma, osteoma, and adenoma. Of these, the chondroma is, in the writers' experience, seen most frequently.

Fibromata are usually found originating from the tunica vaginalis, from the tissue of the albuginea, or in the rete testis. They are generally small and, as a rule, cause but little or no disturbance.

Testicular chondroma may arise in any part of the organ, and may attain considerable size. These tumors are very prone to be associated either with carcinomatous or, more frequently, with sarcomatous growths. Though innocent in immediate nature, they should always be removed.

Osteomata are most commonly found associated with the cartilaginous tumors or with the myxoma.

True *adenoma* of the testicle is of rare occurrence. Adenoma is commonly found associated with carcinomatous growths of the organ, and since all adenomata are very prone to become malignant if allowed to remain, they should be removed.

Of the *malignant tumors* of the testicle, *sarcomata* have most frequently come under the writers' observation. As a rule, these tumors presented lesser degrees of malignancy, occurring as fibrosarcoma or chondrosarcoma. Early removal generally warrants a better prognosis than in most cases of sarcoma occurring elsewhere. Sarcomata are very commonly confused clinically with tuberculosis and syphilis of the testicle, which they strongly resemble in their gross anatomic appearance.

Primary carcinoma of the testicle is somewhat rare, although carcinomatous invasion from an epithelioma of the scrotum, commonly known as "chimney-sweep's cancer," is relatively frequent. The prognosis in carcinoma of the testicle is less favorable than in sarcoma, owing to the abundant lymphatic supply and to infection of the inguinal lymph-nodes, which commonly results early in the progress of the disease.

Of the more unusual forms of malignant tumors of the testicle, the writers have seen several cases of *hypernephroma* and *endothelioma*. On account of the great variety of these tumors, however, and the fact that their treatment is similar to that demanded in sarcoma and carcinoma, a more detailed description is not warranted.

Varicocele.—This condition consists of an enlargement of the veins and cords in the pampiniform plexus. The diagnosis is

easily made by feeling the mass, a sensation being imparted to the touch as if a bunch of thick worsted were grasped. Varicocele gives rise to very few symptoms, although it is believed to cause occasional attacks of nuralgia in the scrotal region. Beyond the application of a suspensory bandage, no treatment is required. When, however, the enlargement is very extensive, the mass being equal to or larger than the corresponding testis, operative proce-

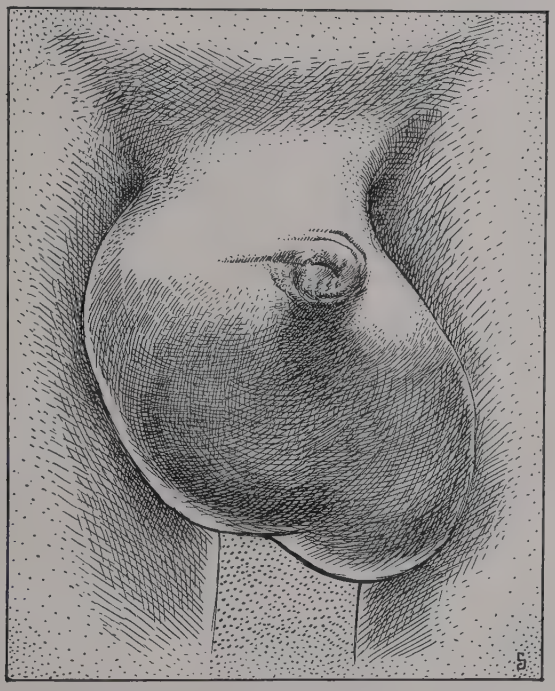


Fig. 289.—Bilateral hydrocele (Frisch and Zuckerkandl).

dure is called for. For a further consideration of the subject, see the chapter on the Treatment of Diseases of the Testicle.

Hydrocele.—Hydrocele of the cord, which is quite common, is almost invariably a localized condition, giving rise to the formation of cystic tumors in the cord, ordinarily of the size of a large marble, and filled by a clear serous fluid. Care should be taken that these tumors are not mistaken for hernia, which they sometimes resemble, and from which they can be differentiated by the fact that the hernial pouch can be usually returned to the abdominal

cavity, the patient lying on the back and the pouch being pressed upward; in hydrocele the mass cannot be thus returned.

In hydrocele there is an accumulation of fluid in the tunica vaginalis testis; the condition can be diagnosed by inserting a hypodermatic needle into the mass, when, if hydrocele is present, a clear, slightly yellow fluid will escape from the needle or can be withdrawn. Besides hernia, the only other condition that at all resembles hydrocele is supernumerary testicle.

The ordinary hydrocele is an accumulation, in the serous sac of the testicle, of fluid resulting from some change that takes place in the walls lining the tunica vaginalis testis. The nature of the pathologic change is not well understood. The accumulation gives rise to a pear-shaped swelling in the scrotum. Generally, the condition is unilateral, but double hydrocele of the tunica vaginalis is not very uncommon. The latter gives rise to a pear-shaped swelling involving the entire scrotum; this swelling is at times enormous; the sac will occasionally hold a pint or more of fluid.

The diagnosis is easily made from the shape of the swelling and from the characteristic resistance on palpation; it can be confirmed by introducing a hypodermatic needle and examining any fluid that may escape. It is unattended with any inflammatory reaction, and does not, ordinarily, give rise to pain. It more commonly attacks the young, in which case tuberculosis sometimes plays a part, or the condition may be congenital. It is also very frequently found in later life, often associated with some change in the prostate or walls of the bladder. Hydrocele is in all probability temporarily associated with attacks of acute epididymitis or orchitis, and ordinarily, in such cases, subsides without special treatment.

Tapping is a conservative measure.

The term *acute hydrocele* has been applied to represent the accumulation of fluid in the tunica vaginalis which accompanies the acute inflammatory condition of the testicle or the epididymis just mentioned, while *chronic hydrocele* is applied to the more ordinary condition, of which we treat in detail. It is customary, in addition to the other measures, to diagnose the various forms of hydrocele by the so-called light test, which con-

sists in a light being placed on one side of the sac, the tumor coming between the light and the eye of the observer, these sacs being translucent.

There are, in addition, several forms of congenital hydrocele caused by some communication between the tunica and the abdominal cavity, or due to retention of some of the fetal tissues. They are comparatively rare and easy to destroy, their diagnosis presenting no great difficulty, and they should be treated as hydrocele of the cord.

Multilocular Cysts.—Although they occur probably but seldom, occasionally multilocular cysts are met with forming a hydrocele. We have operated on one such case. They can be diagnosed before operation, which is probably rarely done, if on aspiration only a small amount of fluid comes away without complete reduction of the sac. The *treatment* should be that of ordinary hydrocele.

Hematoma of the Cord.—In this condition a tumor is present in the cord which may be encysted or may extend well along the length of the cord. It is due to and made up of an infiltration of blood from the blood-vessels. These tumors are caused by an injury to the cord of some character. The *diagnosis* is easy from the history of the case, the presence of a hard, non-translucent tumor, which does not involve the testicle or the epididymis, and which is not reduced when the patient is in a reclining position, as would be the case if a hernia were present.

The *treatment* is to open the tumor. If possible, remove any cystic wall present. The infiltration may be so diffuse, as in the case treated by one of us, that this procedure cannot be carried out. Scraping out the infiltrated material, however, is eventually followed by a gradual absorption of any thickening that may remain in the cord.

ELEPHANTIASIS OF THE SCROTUM

Elephantiasis of the scrotum is due to some defect in the circulation through the lymph-canals, such as might result from the formation of cicatricial tissue following an operation or a wound of the scrotum, or it may be due to pressure of the Filaria sanguinis hominis.

This subject is becoming of such importance that it has been

thought advisable to rewrite the article from our previous edition and to consider it more in detail. Curiously enough, most of the information obtainable comes from French sources, probably owing to the tendency of South Americans to visit France in the past and consult surgeons there. Since the Spanish War cases of filaria are seen more and more frequently in this country. A very good article has recently been written on this topic in the "Malades des Organs Genito de l'Hommes," by A. Dentu and P. Delbet, Paris, 1916.

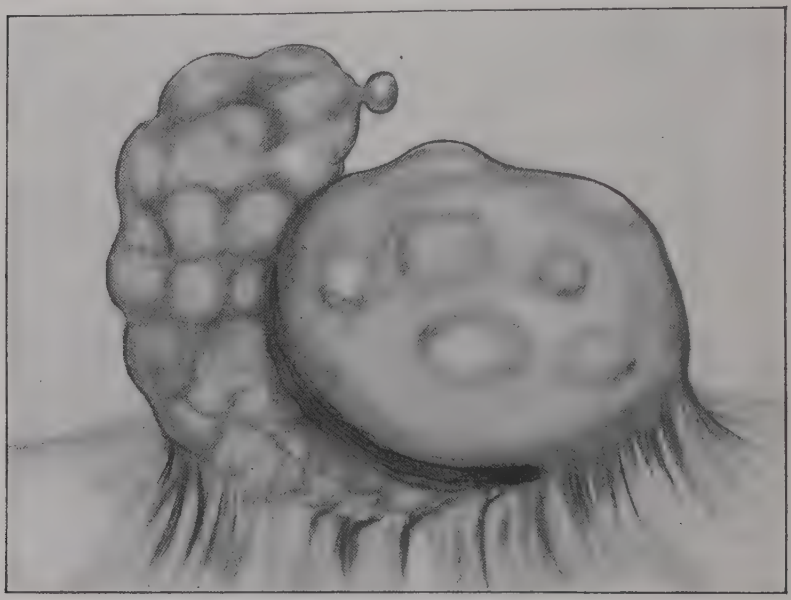


Fig. 290.—Filaria of testicle (after Dentu and Delbet).

The organism is found in the blood, into which it apparently journeys from the lymphatic system. It appears during sleep, and is naturally to be found about midnight. Its marked characteristic is to attack the lymphatic system, particularly the lymphatics of the scrotum and of the cord, the tunica, and the testicle. It is perhaps carried by means of mosquitoes, as is the malaria plasmodia, and the old ideas concerning its infestion of the system from water and entrance through various orifices through bathing are probably incorrect.

As regards its general treatment, quinin, arsenic, salvarsan, and generally the various malarial antidotes are useful. General ig-

norance seems to prevail, particularly in this country, with regard to the frequency of its occurrence. It is found in India, it is so stated, and, what is of particular interest to us, it is found with very great frequency in certain parts of South America, including the West Indian Islands.

In the article above referred to it is stated that 50 per cent. of the inhabitants of the island of Guadeloupe are infected with filaria. Our personal observations would seem to show us that a small proportion of the inhabitants of Porto Rico suffer from the effects of this disease.

Probably the most effective of all treatment is removal to a colder climate. It seems to be the consensus of opinion of the sufferers from this disease that the parasite does not develop in a cold climate, although it may not be entirely eradicated and may lie dormant and give rise to acute exacerbations on returning to the source of the original infection. It is particularly prone to attack, as previously stated, the lymphatics, either genital or perigenital, in the latter case giving rise to such conditions as varicosity of the lymphatics in the buttocks. It probably acts by causing a chronic inflammatory condition, or else its effects are due to mechanical blocking of the lymphatic system. When its lesions first appear there may be a sudden onset attended with chill and fever, or the symptoms may develop insidiously; it may cause a hydrocele containing milky fluid; it may, probably indirectly acting in some way from pressure, cause hydrocele with the ordinary clear fluid in which the filaria cannot be discovered, as in a case operated on by one of us. It may cause a hydrocele of the cord resembling some other tumor of the cord and may cause such a distention of the inguinal lymphatic as to resemble a hernia.

It is extremely prone to cause epididymitis and orchitis, either of an acute or subacute character. The general appearance of these lesions is very well shown in the illustration presented, and is similar to what have been seen by the authors at operation. It is best known as being the principal cause of elephantiasis.

The **diagnosis** depends to a considerable extent about the occurrence of the filaria in the neighborhood. As previously stated it is at times difficult to demonstrate in the blood, although this is the only certain means of diagnosis. Generally speaking, the

lesions are fairly characteristic, as the infiltrated tissues are made up of characteristically dilated or inflamed lymphatic tissues and channels. It is difficult to differentiate between such changes and those due to simple inflammatory processes.

The **treatment** of the changes caused by filaria is essentially surgical. The operative procedures should be similar in character to those instituted for similar conditions due to any cause. The testicles may be so embedded in the tissues that they may be hard to separate, and in such cases the cord should be used as a guide. In operations for elephantiasis, even when this condition is due to other causes than that of filaria, a partial operation may be of aid when it is impossible owing to the amount of involved tissue to do a complete one. There may be such an invasion of the skin surrounding the neighboring organs that further plastic operations may be necessary to fill in the surfaces from which the skin has been removed. This subject is again considered in the section on "The Surgery of the Testicle and its Covering."

The **prognosis** in some of the conditions caused by filaria, particularly those around the testicle and the epididymis, would seem to be better than when it is performed for similar conditions due to other causes. An operation, though not absolutely complete, seems to have a tendency to stimulate the normal functions of the system to overcome the disease. This is our opinion as arrived at from a consideration of the literature on the subject, and from reports of cases made to us personally, and from the limited opportunities we have had of observing the after-effect of surgical treatment in these diseases. It is particularly urged that as much of the testicle be left behind as possible, even when it is apparently wholly diseased, not only for its cosmetic effect, but apparently from the unusual energy which nature seems to display in throwing off diseased conditions when due to this organism, after these conditions have once been attacked surgically. The prognosis should, however, always be guarded as to a recurrence of the condition if the infection cannot be eliminated.

CHAPTER XXIX

THE TREATMENT OF DISEASES OF THE TESTICLE

THERAPEUTIC MEASURES

But little need be said regarding the medical treatment of diseases of the testicles. These affections are, however, so common that the general practitioner should have a good understanding of the surgical treatment of these diseases, and the surgeon should have a clear knowledge of the various procedures that should be adopted before surgical interference is resorted to. When the latter is indicated, it usually is necessarily radical.

It should be borne in mind that the testicle and its covering are particularly prone to be the seat of tertiary syphilitic deposits. The writers have seen them in persons who gave no history of the presence of primary or secondary lesions. These syphilitic deposits, as is well known, disappear rapidly under syphilitic medication. In a doubtful case, where the testicle or the epididymis is greatly enlarged, it is well to give full doses of mixed treatment or of potassium iodid, in addition to which applications of a mercurial ointment may be employed or mercurial inunctions may be applied to other portions of the body than the testicle, and the scrotum anointed with iodin-vasogen, which should be well rubbed in.

Repeated attacks of epididymitis or orchitis without apparent cause should give rise to the suspicion of syphilis being a factor in the case. The medicinal treatment of the most common forms of *testicular inflammatory* conditions, viz., epididymitis or orchitis of gonorrheal origin, should be divided into two classes—one having a direct effect on the testicular inflammation, and the other on the system generally. Of the first class of remedies, the tincture of pulsatilla apparently exerts a benign influence, given early in the attack in drop doses repeated hourly—ten or twelve times in twenty-four hours. The second class of remedies consists of tonics containing iron and quinin, which are of great value in these conditions for the purpose of maintaining or improving the general

health. Very rarely in an attack of epididymitis, particularly in relapsing cases, the pain is so severe that morphin hypodermatically is necessary for its relief.

The tendency of *tuberculosis* to attack the testicle should always be borne in mind. Occasionally this is the only organ in which the disease makes itself manifest. Acquired hydrocele, especially in young persons, is apt to be of tuberculous origin. In addition, small deposits of inflammatory products caused by tuberculosis—so small as hardly to be perceptible—are not infrequently to be found in the testicle or the epididymis. It is interesting to observe, in these cases, how a slight injury will cause these tuberculous products, which may lie dormant for months and years, to serve as the starting-point of an inflammation involving the testicle and the epididymis. Of three cases of this type encountered, who gave a history of the same slight injury,—slipping without falling on the pavement,—in two there was no history of gonorrheal infection; in the third, some twenty years had elapsed since gonorrheal manifestations had presented themselves; in the three cases each developed an acute orchi-epididymitis. In the first two of these cases the inflammatory symptoms disappeared in a few days under rest and the application of a lead-and-opium wash. In the third case, because of the good results obtained in the first two cases, a very favorable prognosis was given. In spite of similar treatment, however, pus rapidly developed; this was evacuated and the cavity cleaned out, but in from twenty-four to forty-eight hours the remainder of the testicle had become so completely disorganized that removal was imperative.

The three cases just described are good examples of what is to be expected from tuberculous invasion all along the urinary tract. Not even an experienced observer can prognosticate what the outcome will be or whether or not an operation will be necessary. The prostate and seminal vesicles, when involved in tuberculous processes, are apparently not quite so likely to cause serious systemic manifestations.

In making a diagnosis of any given obscure case, the practitioner should carefully examine the testicle for evidences of tuberculosis or syphilis; frequently the only lesions of these diseases that can be

well marked out are found here. Internal medication other than that indicated for the disease itself is of no apparent benefit in the treatment of tuberculosis of the testicle or its covering.

As regards external measures for the relief of acute inflammatory conditions of the testicle, such as acute orchitis and acute epididymitis, rest in bed, when it can be secured, is imperative. While resting, the testicles should be supported on a bridge placed between the legs, running across under the legs just anterior to the scrotum. This bridge may be constructed of a towel passed around

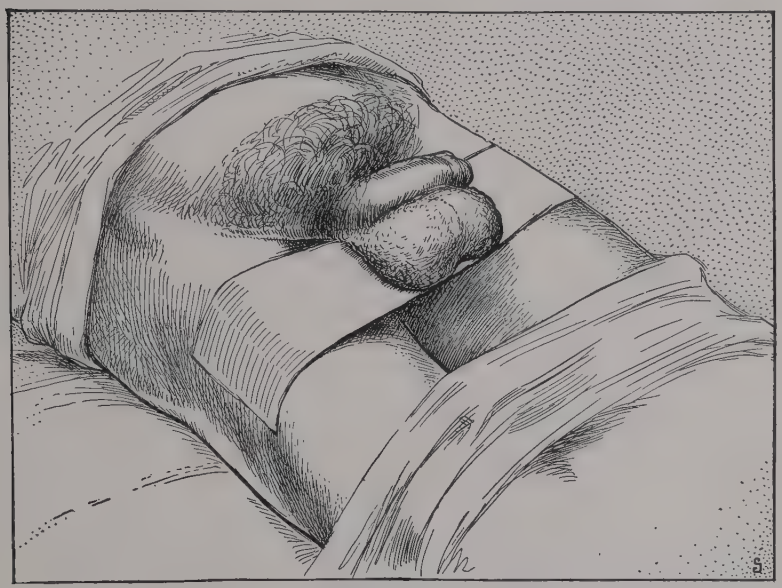


Fig. 291.—Showing "bridge" for support of scrotum in epididymitis.

the legs or of adhesive plaster. In these acute inflammations the ordinary local applications, such as are used for similar conditions occurring elsewhere in the body, are indicated. Generally they consist of either heat or cold, using that which gives the most relief. There is some danger of sloughing following the too prolonged use of the ice-bag, and for this reason it is safer to employ heat. Lead-and-opium wash, applied on bits of gauze, as hot as can be borne, changing as often as it becomes cool, is, in the writers' experience, productive of much comfort, and is to be advised when

the services of a constant attendant can be obtained. An application consisting of opium and belladonna ointments, equal parts, is serviceable. These ointments may be applied on a piece of lint, over which an oiled silk dressing should be placed, retained in position by a suspensory bandage. When the acute process has somewhat subsided, ordinarily in a few days, which is generally evidenced by a diminution of pain, even when the swelling remains, patients may be allowed to sit up, but should be cautioned against moving about for a few days, because of the danger of relapse. The applications previously advised may be continued, or a 10 per cent. ichthyol ointment may be used; or, if desired, the scrotum may be painted with 10 per cent. guaiacol diluted in alcohol, or with a solution of silver nitrate, 40 or 60 grains to the ounce. When the acute inflammatory processes, such

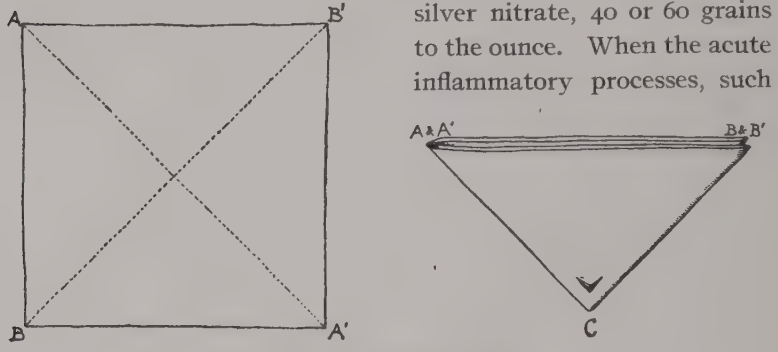


Fig. 292.—Bandage for scrotum.

as are associated with epididymitis or orchitis, have disappeared, small foci of inflammatory products will very often be found remaining in the testicle or epididymis. In order to secure the best results, local applications to the scrotum in the region of such foci should be made for many weeks and months. A 10 per cent. ointment of lead iodid may be used, or the iodin-vasogen may be applied daily. When such conditions are believed to be tuberculous, vasogen and guaiacol may be used; if syphilitic origin is suspected, a 5 per cent. ammoniated mercury ointment may be applied. It is hardly necessary to mention the necessity of instituting proper constitutional and hygienic treatment, as well as local measures for the relief of any lesions of the urethra that may exist.

SURGERY OF THE TESTICLE AND ITS COVERING

In considering the surgical treatment of diseases of the testicle, the operative procedures for the relief of diseased conditions of the covering of the testicle come first in order. Of these, hydrocele is the most common.

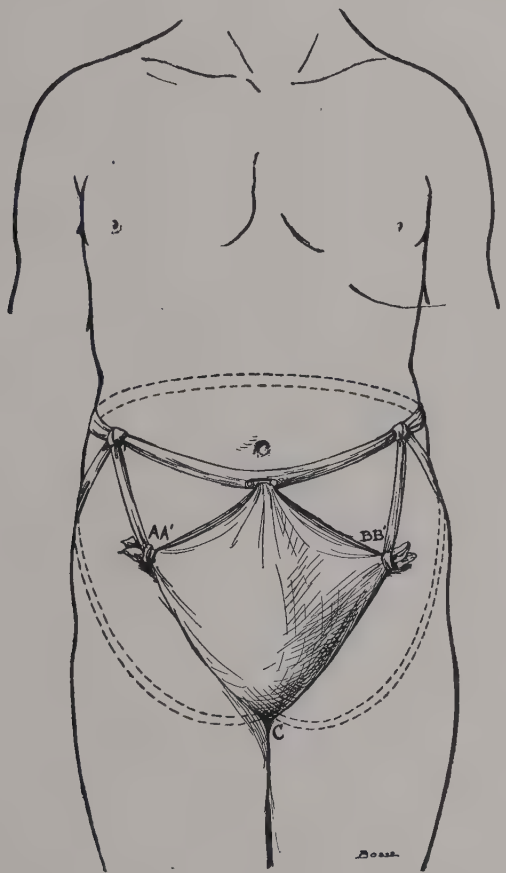


Fig. 293.—Bandage for scrotum.

Operation for Hydrocele

This, as has been said, is a very common affection; it may involve the entire tunica or only a portion; it may be lobulated. Hydrocele, which may involve the covering of one or both

testicles, and which is seen in both the young and the old, is so frequently met that many attempts have been made to devise an ideal operation for its cure, but thus far these attempts have been futile. The simplest operation for the relief of hydrocele is that which consists of tapping by means of a trocar; this is an operation that almost every practitioner is called upon to perform at some

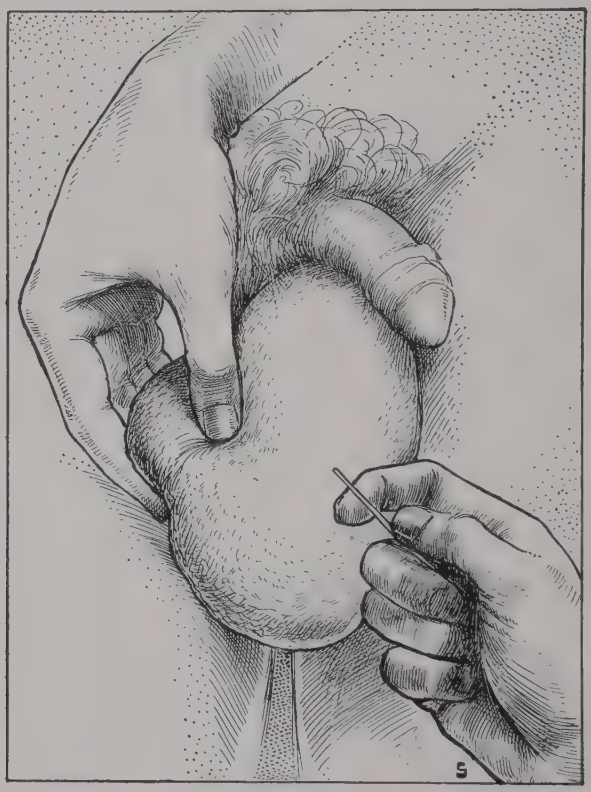


Fig. 294.—Tapping a hydrocele.

time. Even in this simple operation, however, proper attention must be given to details in order to secure the best results. When possible, in tapping a hydrocele, it is well to have the services of an assistant. After aseptic precautions have been observed, the assistant locates the testicle in the mass, holding it with one hand, and making the bag of fluid protrude in such a manner as to render it as tense as possible. The surgeon then selects the most promi-

nent part of the bulging mass, washes it with some antiseptic solution, and sprays the point where it is purposed to introduce the trocar with ethyl chlorid; the smallest trocar that it is practicable to use, which should be sharp and sterile, should be plunged quickly and deeply through the covering of the testicle into the sac, and the fluid allowed to escape into a proper receptacle. After the fluid has escaped, the surrounding areas should be submitted to a sort of milking process, in order to be certain that no fluid has been left behind in the folds of the tunica; the trocar should then be quickly withdrawn and a strip of adhesive plaster placed over the site of the puncture. Occasionally, even in the hands of an experienced operator, particularly when the services of an assistant are not to be had and when the walls of the sac have become very much thickened, the testicle is wounded by the trocar. As a rule, beyond the pain it causes, no particular harmful results follow this accident.

It has been a common custom for a great many years to inject into the sac, through the trocar, a few drops of a powerful destructive agent, with the object of setting up an adhesive inflammation between the walls of the tunica that will cause them to adhere and thus prevent the reformation of fluid. This method is sometimes successful. The fluid most generally used for the purpose is phenol; not more than five or ten drops of 95 per cent. pure phenol should be used. A few drops of a strong solution of iodin may be employed. The reaction following this procedure is generally marked. For several days swelling and pain are severe, but gradually subside, and, in fortunate cases, the fluid does not return.

Personally, the writers prefer one of the radical operations, three of which are at the present time in use. The old operation consists in making a lengthy incision through the skin down to the tunica, carefully dissecting away the tissues on each side, and tying off any bleeding points; when the tunica is reached, it is a good plan to hook it before puncturing the sac with a knife, for, simple as the procedure is, it is sometimes difficult, if the sac is punctured too soon and the fluid suddenly escapes, to map out and bring into the field of vision the proper walls of the sac. The sac having been hooked, it can then be punctured and a small

artery forceps immediately applied to the wall of the sac on each side of the incision; the fluid having escaped, a finger may be introduced into the sac and the testicle examined; if desired, it may be brought out through the sac, looked at, and returned.

In the older method of performing the operation quite a long incision was made, and a few sutures were passed through the wall of the tunica, brought out through the skin of the scrotum

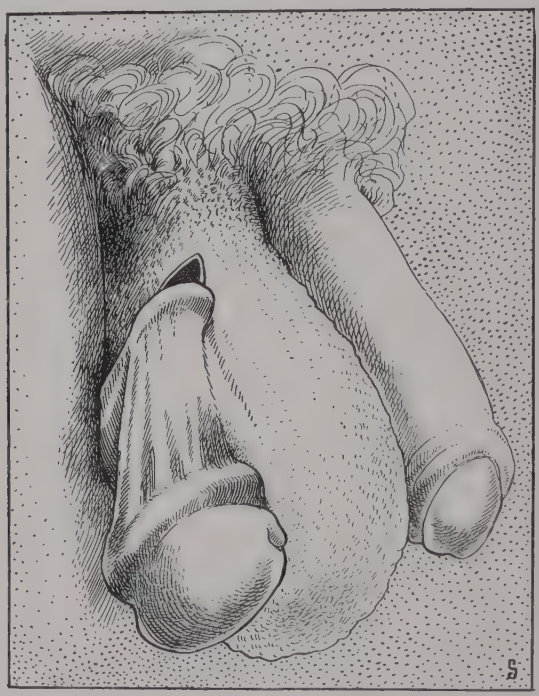


Fig. 295.—Eversion of tunica vaginalis for the cure of hydrocele.

so as to fasten the wall of the tunica to the scrotum, and the wound then packed with gauze, which was removed in a few days; this left a fistulous opening which took some time to heal, but was often successful in curing the annoying hydrocele. In the second method, which is a modification of the first, many surgeons, after incising the sac, remove the tunica almost entirely, and then, under proper antiseptic precautions, immediately sew up the in-

cision. This method has many followers, and is at the present time very generally used.

The third method, originally devised by the French, but erroneously credited to the Germans, is to make the incision through the sac, releasing the fluid; a finger is then inserted into the wound,

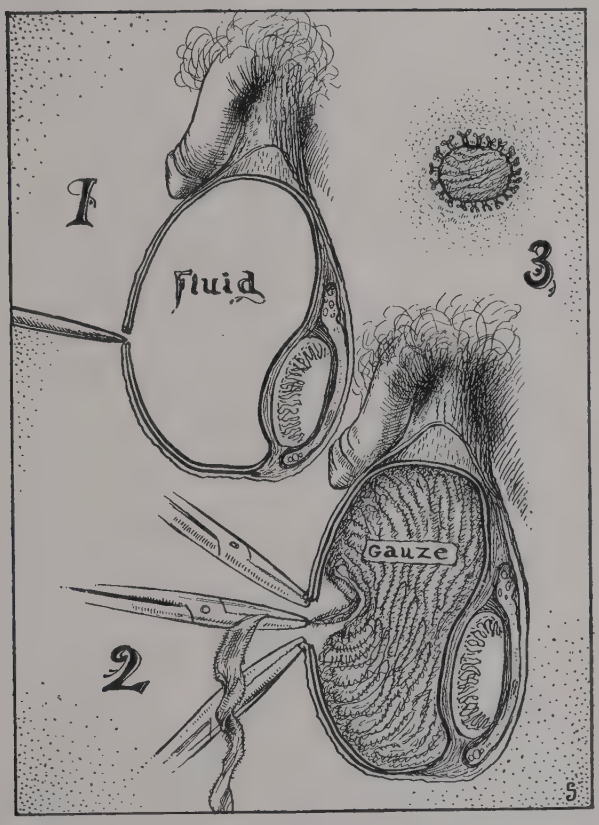


Fig. 296.—Operation recommended for the radical cure of hydrocele: 1, Opening sac; 2, packing cavity with gauze; 3, method of stitching opening.

and the testicle pulled out, which has the effect of turning the sac inside out—in other words, inverting it; the skin wound is then sutured immediately over the testicle. From without inward then the order would be: first, skin; second, testicle; third, sac; instead of—first, skin; second, sac; third, testicle, as is the normal order. This procedure almost absolutely prevents any recurrence of

fluid in the sac. When, however, the walls of the sac are very thick, this procedure cannot be carried out, for when the testicle is pulled out through the wound and the sac inverted, the mass is so large that there is not skin enough in the scrotum to cover it. The writers were among the first to perform this operation in this country; they also published one of the first articles in English describing it.

The reaction following this operation is generally marked, and the patient should be kept in bed for a week or two, at the end of which time the swelling of the testicle, which as a rule takes place, subsides. Following any of these operations rest in bed should be insisted upon so long as the testicle is swollen, and warm or cooling applications, if it seem best, should be made to the inflamed parts. At times severe pain in the abdomen follows the removal of fluid from the sac. In these cases morphin may be given, the pain generally lasting only a few hours.

The ideal operation for the radical cure of hydrocele has not yet been discovered; the following method of operation, however, seems to us to possess certain advantages deserving of consideration. One of these is that it tends to preserve the function of the testicle. By removing the tunica the natural covering of the testicle is destroyed, and it would seem to follow, as a matter of course, that the adhesion with connective tissue that would take place between the testicle and the skin, through its power of contraction, would have a bad effect upon the functional capacity of the organ. The same objection holds good for the operation of inversion of the tunica just mentioned. Excluding these two operations, the old-fashioned operation first described now remains to be considered. As against this method may be mentioned the fact that it was not always successful, often leaving a sinus that was likely to persist for many weeks.

From a suggestion of Dr. Ramon Guiteras, the writers were led to adopt, in their hospital and private practice several years ago, a method for which they claim no particular originality, since it is merely a modification of the old operation; it is, however, generally successful, and is comparatively easy to perform. To obtain the best results it is necessary that great care should be given to detail and to asepsis. The operation may be performed in the surgeon's

office, the patient being sent home in a carriage. The scrotum having been rendered aseptic, cocain is injected over the site of the proposed incision; ethyl chlorid is next sprayed on, and a small incision, about an inch in length, much smaller than was the custom to use in the original operation, is made down into the sac, and the fluid allowed to escape. The walls of the tunica and scrotum are now carefully stitched together with many very fine catgut sutures. If great care as regards cleanliness and sterilization is not observed in performing this operation, and if the wound does not receive the proper after-care, infection, followed by sloughing in the wound between the skin and the tunica, is likely to take place. After the scrotum and skin have been carefully sutured, a very narrow, ribbon-shaped strip of gauze is introduced into the wound and packed down quite firmly. To obtain the best results it is necessary to leave the gauze in the sac for at least four, and possibly ten, days, provided there has been no rise in temperature, and that the discharge gives off no offensive odor, or that no untoward symptom arises rendering its earlier removal advisable. At the end of this time the gauze may be removed and the patient allowed to leave his bed and go about. Any existing sinus will close in a few days, instead of persisting for weeks or months, as was formerly the case when the original operation was performed. The modifications here described may seem unimportant, but experience has convinced the writers that they are worth while, for when the hydrocele is cured as the result of this operation, the testicle still retains its natural covering.

Encysted hydroceles of the cord are generally small, and are often mistaken by the laity for a supernumerary testicle. They are generally about the size of a marble, and give rise to no pain or suffering. They should be aspirated with a fine needle or fine trocar, and their entire contents allowed to escape; when this is done, they disappear and do not return.

Epididymectomy

This operation consists in removing the whole or a portion of the epididymis. An incision is made through the scrotum, and the epididymis exposed; beginning at the tail of the epididymis, it may be dissected off, working from tail to the head. The culdesac

of the tunica vaginalis supports the tail of the epididymis from the testicle proper, thus rendering dissection of the former easy unless it is bound down by adhesions. The blood-supply is more abundant about the head than about the tail of the epididymis. Instead of removing the entire body, only a portion of the epididymis may be removed, as the surgeon sees fit.

After the epididymis, or a portion of it, has been removed, and all bleeding points have been carefully ligated, the wound should be packed lightly with gauze and allowed to granulate; or, if healthy, it may be completely sewed up, as much of the albuginea as possible being sewed over the resected area. There is much diversity of opinion regarding the value of this operation. It has received a great deal of attention from writers, and many favorable results have been claimed for it, particularly in cases of tuberculosis of the epididymis or testicle. When the epididymis is removed, wholly or in part, a portion of the testicle itself may, if desired, be removed simultaneously, or a cheesy nodule in the epididymis may be simply curetted out and packed with iodoform gauze. So far as personal observation goes, the favorable results claimed for epididymectomy have not been substantiated. This operation is perhaps indicated in some cases of actual or suspected tuberculosis of the epididymis. It is very rarely demanded for any other disease. In a case of tuberculosis the operation may be undertaken, and, if it proves unsuccessful, the entire organ may be removed later on. It should be borne in mind that these tuberculous infections sometimes progress rapidly, and that an incomplete operation, such as this is, tends occasionally to hasten the progress and disseminate the disease. The patient's condition should, therefore, be watched very carefully; following the operation he should be seen often, and the surgeon should be prepared to perform castration at a moment's notice.

Castration

Castration, or the removal of the testicle, is generally required either for tumor of the testicle, generally of a malignant type, or, most often, for tuberculosis; occasionally injury necessitates its removal. Castration was formerly practised for the relief of enlarged prostate, but at present this procedure has been abandoned in the treatment of that condition. In view of the fact

that the operation is consented to only as a last resort, and that any right-minded surgeon would hesitate to practise it unless the necessities of the case urgently demanded it, castration is not often performed unnecessarily.

Ordinarily, castration is a very simple operation. An incision about two or three inches long, extending from the upper border of the scrotum up into the groin, is made through the skin and

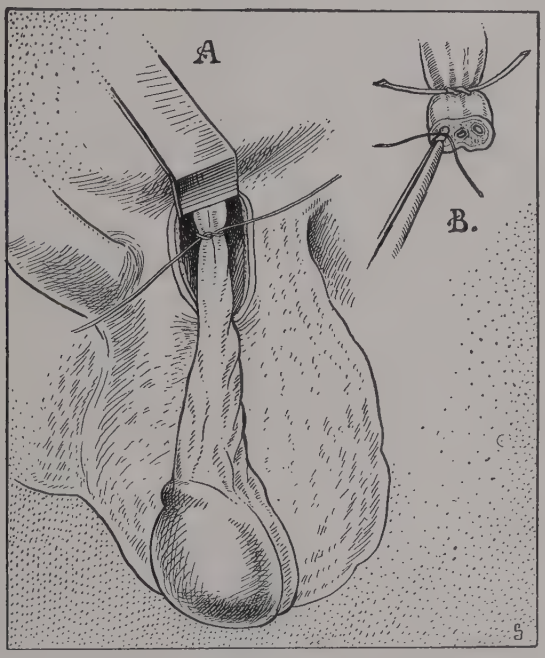


Fig. 297.—A, Operation of castration. B, Method of tying stump of the cord.

fascia down to the cord; the cord is isolated, and with the testicle attached, is pulled out through the opening; ligatures are then placed about it, and with a knife or scissors the cord is severed below the ligature and the testicle thus removed. The edges of the wound in the scrotum are brought together, and a small gauze drain is inserted at its lower angle and allowed to remain for a few days. Ordinarily, the writers advocate an incision longer than laid down in text-books on surgery, extending toward the bottom of the scrotum, and longer than shown in the illustration, for the purpose of securing better drainage. It is gen-

erally considered good surgery, in removing the testicle, to perform the amputation as high up on the cord as practicable. Some writers also recommend separating the vas deferens from the cord, pulling on it gently, and dissecting it away wherever possible; in other words, attempting to "unravel" it, so to speak, so that in some cases it will be possible to amputate it an inch or two higher than is the cord. This is done in the belief that the more of the vas deferens removed in tuberculosis of the testicle, the less tendency is there for the seminal vesicles to become infected. In a case occurring in the writers' hospital service, in which this modification of the operation was very successfully performed, an intensely painful rectal neuralgia followed; this tended to discourage us with the procedure. Although in other cases the vas was unraveled and amputated as high as possible without any bad after-results, the writers do not believe that they have accomplished any particular good by so doing, and consider it a procedure of little value, and believe it better to divide the cord without unraveling the vas. In dividing the cord below the ligature, the ligature is allowed to remain; in some cases the portion below sloughs off and considerable swelling takes place in the extreme end of the stump of the cord. To obviate this the writers place a temporary ligature about the cord before amputating, and then sever the cord; the ligature is then loosened slightly and, with very small artery forceps, the bleeding points that appear in the stump are picked up carefully and ligated with fine catgut, after which the ligature is removed entirely. Following the amputation and removal of the testicle it is generally wise to leave a small drain at the bottom of the wound for a few days. Considerable local reaction around the stump of the cord immediately follows the operation, and marked swelling, that seems inclined to extend up the abdomen, may occur. If proper attention is paid to drainage and an ice-bag applied, this will generally diminish. In some cases changing the position of the patient, so as to secure better drainage, is in itself enough to cause an increasing and angry-looking swelling to disappear entirely. In removing a testicle that has become very much enlarged, particularly as the result of malignant disease, the infiltration around the testicle is so extensive that it appears as if it were in a mold. In such cases it must be dissected out with considerable care. After its removal the thickened mass

may be dug out from the scrotal walls, care being taken not to injure the dividing wall between the two testicles.

Treatment for Inguinal Retention of the Testicle

In the writers' personal experience these cases occur with comparative frequency. They are of congenital origin, the testicle rarely giving trouble when retained in the abdomen. They seldom give rise to pain; when they do, however, operation should be performed. The condition manifests itself as a mass in the groin, resembling hernia, for which it is sometimes mistaken. Two forms of operation are employed for the relief of these cases: one consists in removing the mass, and the other aims to restore the organ to the scrotum and anchor it there. The operation of removal should be carried out in the same manner as the ordinary operation of castration, the incision being made in the groin over the misplaced organ. It is a very difficult matter to anchor a misplaced testicle permanently in the scrotum, and where it is so anchored, it is doubtful if it will ever possess any functional activity. The good results from various operations that have so often been reported have not been attained in the writers' practice, and they are generally inclined, therefore, particularly when the case to be operated upon is an adult, to recommend removal of the organ. The difficulty in all operations for effecting retention of a misplaced organ in the scrotum is that the cord has become so shortened that when the testicle is brought down into the scrotum and anchored there, the tension of the cord will soon cause it to ascend again into the groin. Another difficulty is that of obtaining a sufficiently long cord to allow of the organ being brought well down into the base of the scrotum. The following method of operating on this class of cases is the one that will probably give the best results. It is the operation devised by Dr. Arthur D. Bevan, of Chicago. The testicle is exposed in the inguinal region. The vaginal process of peritoneum is divided and ligated above it as a hernial sac; the portion of peritoneum that surrounds it is closed by a purse-string suture. The cord is lengthened by pulling upon it and dissected free from connective tissue; a place is made for the testicle in the scrotum and it is, with its artificial tunica vagina, brought down into it and kept there by a purse-string suture run through the neck of the scrotum. If sufficient length

of cord cannot be obtained, the spermatic blood-vessels may be ligated, trusting to the artery of the vasa deferentia to nourish the testicle.

There are several other methods of treatment for this condition. Dr. Paul Coudray[1] claims that where hernia is not associated with the ectopia that massage and traction, together with the use of a properly applied bandage, will in time cause the organ to remain in the scrotum, while with hernia it is necessary to do a radical operation. Another method that has frequently been advocated is to pull the testicle through a slit in the bottom of the scrotum and allow it to remain in that position for a time, the contraction of the scrotal wall preventing it from slipping upward into the groin.

C. B. Keetly[2] brings the testicle through the bottom of the scrotum, then makes an incision in the corresponding portion of the thigh of the same extent as the incision in the bottom of the scrotum, attaches the testicle to the cellular tissue underneath the skin, and sews together the opening in the skin and the scrotum. He reports a considerable number of cases operated on in this manner. In detail his procedure is as follows: "The testicle and cord having been thoroughly freed from everything but the musculo-fibrous bands form in the gubernaculum, which are generally attached to the pillars of the external ring, especially the internal pillar, the gubernaculum is divided, as far away as possible from the testicle. A pair of forceps is then passed from below upward, through the hole in the scrotum, and the gubernaculum is seized by it and pulled right through the scrotum until it can be seen through the hole in the skin of the scrotum. At the same time the tunica vaginalis testis should also be pulled down into the scrotum, although it is not absolutely necessary to keep the testis in its serous bag. Indeed, I have often omitted to attend to this point. The posterior borders of the aperture of the skin of the scrotum and thigh are next united by continuous silkworm-gut suture left long at both ends. Now the gubernaculum testis is sutured with strong catgut to the fascia lata of the thigh, and lastly the original silkworm-gut suture is used to complete the union of the

[1] "Traitment de l'ectopie Testicularie, par Male," "La Progres Médical," January, 1907.

[2] "Lancet," 1895.

skin apertures in the scrotum and thigh to one another. The hernia which is generally present is operated on for radical cure in the way the surgeon thinks best for the individual case."

This method was first demonstrated in 1894. The authors recommend to leave the testis attached to the thigh for five months. Fritz de Beule[1] recommends the same procedure, having devised the operation before becoming acquainted with the work

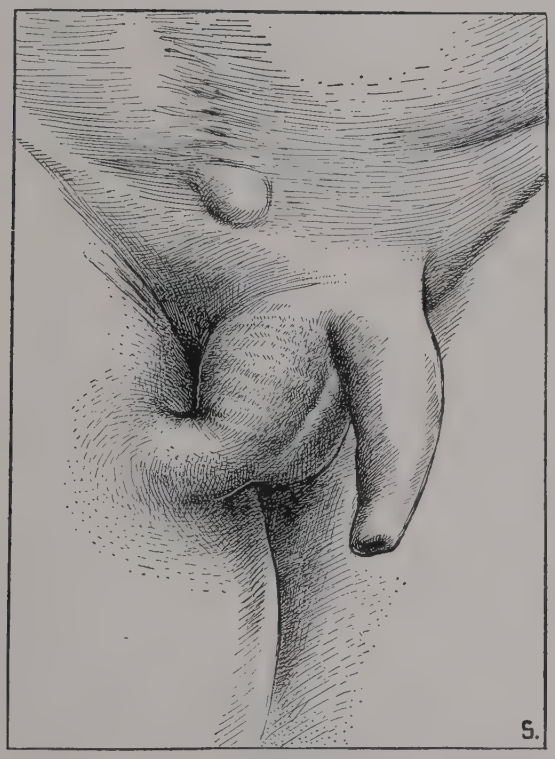


Fig. 298.—Method of retaining testicle in thigh (redrawn from Keetly).

of C. B. Keetly. His procedure is about the same, with the exception that he releases the testicle retained in the thigh at the end of about five weeks. Gersuny and Witzel developed a method of opening the wall which divides the scrotum into two halves, and places the right testicle in the left cavity and the left testicle in the right. Very recently Dr. Simard[2] has reported a case oper-

[1] "Anal. Soc. Belg. de Chir.," 1906.
[2] "Bull. Med. de Quebec," 1907.

ated on in this manner in which, after the end of six months, the results were found to be good. We have seen one case which had been operated upon by the Keetly method in which apparently good results had been achieved, and are inclined to believe, judging from the histories of reported cases, that in a proportion of cases this method will be found efficacious. It is claimed by the author that, through operating in this manner, the life of the testicle is not destroyed.

The Treatment of Atrophy of the Testicle

For the local treatment of atrophy of the testicle some form of electricity has for many years been advocated. The interrupted or continuous current or static electricity is employed. When the first-named currents are used, one of the electrodes is applied over the lower portion of the spine and the other along the perineal and scrotal tissues. Such measures should, however, be adopted tentatively, and the strength and duration of the application modified to meet the demands of the individual case.

The Treatment of Injuries to the Testicle

The treatment of injuries of the testicle is largely dependent upon their severity. Patients should be put to bed and the scrotum supported in a manner similar to that recommended for the treatment of other acute inflammatory conditions. Either hot or cold applications, according to which affords the most relief, should be used. The ice-bag is ordinarily the best external application, but, as previously mentioned, it must be remembered that sloughing is likely to follow its too prolonged use.

After a severe injury, such as a violent kick, considerable swelling is likely to occur, and an effusion of blood that gives rise to a hard tumor, known as a hematocele, may occur. These hematoceles may persist for weeks or months. If they are not eventually absorbed, they should be removed. Penetrating wounds, either immediately or shortly after they have been received, sometimes permit the testicle to prolapse through the scrotum, and occasional hernia of the testicle results. In these cases, either with or without hernia, the organ should be replaced and the wound sutured under proper antiseptic precautions. Whenever practicable, the testicle should be replaced as soon as possible after the

injury, before adhesions between it and the surrounding tissue have had an opportunity to form.

The Treatment of Varicocele

There is probably no other condition that has offered a more lucrative field for the practice of charlatanry than varicocele. This condition, which consists of an enlargement of the veins of the spermatic cord, very rarely gives rise to any physical symptoms or effects any damage if allowed to go untreated; the feeling of weight, uneasiness, burning, and the like in the scrotum, or pain in the back, often thought to be caused by it, being, we think, due to neurasthenia, or possibly reflex from some inflammatory condition in the urethral tract. Very often, however, it produces mental distress. The application of a suspensory bandage is, in most cases, all that is required. When surgical procedure is demanded, one of three types of operation may be chosen.

The first, subcutaneous ligation, has, to a great extent, become obsolete. It is, nevertheless, recommended by many, and various methods of performing it have been described in the older textbooks on surgery, to which reference is made. We do not commend it.

The second type of operation aims to reduce the redundancy of the scrotum, by effecting ablation of part of the sac. This procedure is probably as useful as any, as, owing to the cicatricial tissue contraction following the operation, it makes a natural suspensory bandage of the scrotum itself. It is performed as follows: The testicles are pushed up toward the inguinal gland, and the base of the scrotum is pulled down and seized between the first and second fingers of the left hand, which are pushed up against the testicles in a manner similar to that of a barber when cutting the hair of the head. A properly fitting clamp is then applied. Any one of the appliances that have been specially devised for the purpose, or any large clamp with a curve, or two clamps from side to side, meeting end to end, may be employed. Just above them, between the clamps and the testicle, a few U-shaped sutures should be placed, the fold of scrotum below the clamp cut through, and the portion of scrotum below the

clamp removed. The clamps are then removed, any bleeding points ligated, and, if necessary, a few more sutures taken. The patient is put to bed and kept there, and a dry dressing is applied until the wound has healed.

The third method of operating consists in making an incision down on to and separating the cord, in much the same manner as if the testicle were to be removed by castration, except that the incision should be somewhat lower. After the cord has been isolated well down to the epididymis and the mass of veins that go to make up the varicocele has been recognized, the cord should be examined very carefully between the thumb and forefinger. The vas deferens, in the midst of the cord, will be recognized as a very small cord by itself, which feels like a piece of wire; the sensation it imparts to the touch is so distinctive that once felt, it will afterward be easily recognizable. Great care must be exercised lest the vas deferens be incised; it should be separated from the remainder of the cord, and the portion of the cord containing the most distended veins should be tied across with two ligatures, one being placed well down toward the epididymis and the other about an inch above. The intervening inch of the cord, containing many of the enlarged veins, should be removed by an incision across the cord immediately above the lower and just below the upper ligature, and the excised piece removed; then the two amputated ends of the cord should be brought together, and the ligatures that run across the cord having been left long, should be tied together, thus bringing the two separate ends of the cord into approximation. In other words, the cord is an inch shorter than it was before the operation; the vas deferens, however, which has not been interfered with, is the same length as it originally was. The ligatures having been tied, the skin incision is then sutured. It is unnecessary to employ drainage, but the patient should be put to bed and should be kept there for a few days, or until the swelling that takes place at the point where the two ends of the cord are brought together, and that makes a bunch of considerable size, has reached its height, otherwise an annoying orchi-epididymitis occasionally follows. If desired, the surgeon may employ a combination of methods: quite a large portion of the skin at the side of the scrotum may be removed, or the two operations of

ablation of the lower portion of the scrotum and excision of the veins, as just described, may be performed.

The Treatment of Tumors of the Testicle

In all cases of tumors of the testicle where malignancy is strongly suspected the writers advocate early and radical operative measures. All doubtful cases should first be submitted to thorough antisyphilitic treatment, followed by operation if this proves unsuccessful. As a rule, the clinical and gross anatomic aspects of the tumor are sufficient to establish the diagnosis, the extent and nature of the operation being then determined at the operating table. For instance, a sessile tumor, as well as some teratomata, may be removed and the testicle allowed to remain if attached to it only by a small pedicle, in this way perhaps preserving the integrity of the testicle. Whenever possible, a rapid histologic examination, by means of frozen sections, should be made during the operation. The writers have known the most serious results to follow delay; it cannot, therefore, be impressed too strongly on practitioners that, in the early stages of tumors of the testicle, a fairly good prognosis as to recurrence may be given if early operation is permitted, whereas delay is almost invariably followed by such wide dissemination as to render treatment of little or no avail.

The *x*-ray, radium, or the Coley toxins should be used only in inoperable cases or when operation is refused.

Irrigation and Drainage of the Seminal Duct and Vesicle Through the Vas Deferens

Recently[1] Dr. William T. Belfield reports on the practicability of using the vasa deferentia as a canal from which drainage of the seminal duct may take place, or through which the seminal vesicles may be reached by injected fluid. His procedure is as follows: Through a half-inch incision, under local anesthesia, the vas is exposed. A transverse or longitudinal incision into the vas opens the canal, and the blunted needle of a hypodermatic syringe may be passed into the minute canal and a watery solution of any desired agent injected; this liquid traverses the vas and the ampulla and

[1] Abstract from "Proceedings of the American Association of Genito-urinary Surgeons," June, 1906.

distends the seminal vesicle. This writer states that 30 minims is the amount of fluid that can safely be used without causing sper-

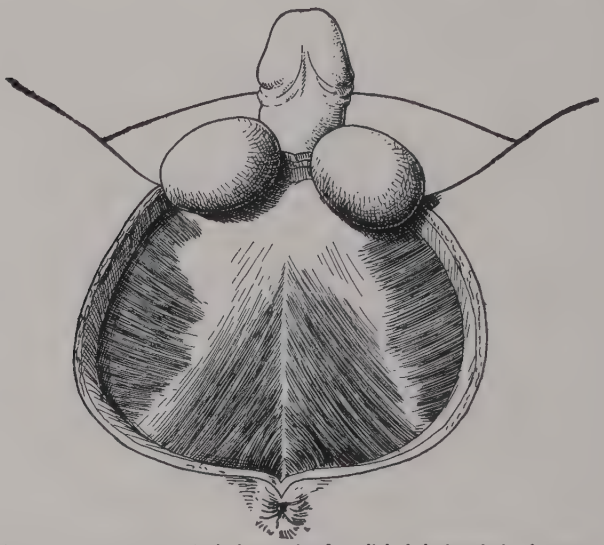


Fig. 299.—Illustrating method of operating for relief of elephantiasis of scrotum.

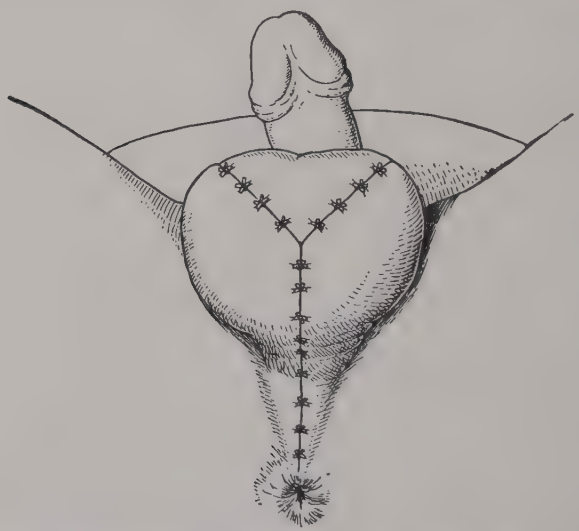


Fig. 300.—Illustrating method of operating for the relief of elephantiasis of scrotum.

matic colic and retention of urine. If desired, the vas may be kept open by passing a fine silkworm-gut suture through the

lumen of each cut end. He states that by means of this method he has successfully treated perivesiculitis and allied conditions.

Treatment of Elephantiasis

The illustrations given clearly define the surgical procedure necessary for the relief of this condition, two semilunar incisions meeting one another at the penoscrotal angle and at the raphé of the perineum near the anus. The testicles should be located, pulled forward, and any attachments between them and the back of the scrotum severed. Then the mass is removed and the operative field covered by bringing the tissues together by the line of incision shown. It is recommended by Berger and Hartmann that the patient rest in bed for two days preceding the operation, with the scrotal contents elevated; through this procedure the mass will be softened and the testicles be more easily located in the growth.

CHAPTER XXX

SEXUAL NEUROSES

Neuroses of the genito-urinary system are of such frequent occurrence as to demand brief consideration here. Patients are constantly applying to the general practitioner for the relief of symptoms that must be classed as neuroses or functional disturbances of the sexual organs. The classification of these symptoms is very difficult, and their treatment is still more so. Only the more important divisions will be considered here; for a more complete description the reader is referred to the work of E. Finger, "Der Störungen der Geschlechtsfunctionen des Mannes," in the "Handbuch der Urologie," edited by Dr. Anton v. Frisch and Dr. Otto Zuckerkandl, Wien, 1906. There is also quite an exhaustive article on the subject in Casper's "Urologie." Reference may also be made to any of the most recent works on mental and nervous diseases.

Under the heading of neuroses of the sexual organs it has been customary to consider disturbances in the function, including such conditions as, first, pollutions, under which heading should be grouped such disorders as spermatorrhea, prostatorrhea, and urorrhea. These unnatural emissions are particularly marked during defecation, or are abnormal in character or frequency. Second, impotence, which is the complete or partial inability to perform the sexual act. More or less connected with it are the various types of sexual weakness when not due to the natural conditions of youth or old age. Third, sterility, which is the term used to express the inability to impregnate healthy females. This last condition has been classified into divisions made up of individuals who are sterile through impotency and those whose semen is unfertile.

The writers take the same stand as does Finger, in his article previously referred to, that such conditions as spermatorrhea and prostatorrhea are but symptoms pointing to some diseased state.

For example, the discharge of semen, if it should occur during defecation or during micturition, may be an evidence of paralysis of the ejaculatory duct, which in turn may be due to peripheral nerve disturbance following a catarrhal inflammation at the neck of the bladder, or to some organic disease of the spinal cord. Clinically, the discharge that occurs under these conditions is more likely to be either a urorrhea, in which no other elements are found microscopically than those normal to the urethra, or, what is still more common, a prostatorrhea, in which the discharge microscopically gives evidence of coming from the prostatic gland. If leukocytes are found in abnormal proportion in any of these discharges, this would be indicative of inflammation existing in the urethra, prostate, or seminal vesicles, and could be anatomically considered as chronic urethritis or seminal vesiculitis. Microscopic examinations of the urethral discharge would, of course, help materially to differentiate the conditions.

For convenience of description, we divide this subject into three general classes: (1) Those in which there is some organic disease of the urinary or sexual apparatus. (2) Those in which the condition is due to a general disease or habit, to a mental defect, or to a lesion of the nervous system. (3) Those cases in which there is a combination of the general disease or mental disorder, with actual lesions or pathologic disturbances in the genitourinary tract. This last class would, therefore, be a mixed one, made up of members of the other two classes in some of whom the organic disturbances, and in others the psychic phenomena, would predominate.

Class 1.—In considering the first class,—those patients in whom there exists some essential organic lesion in the genitourinary tract,—we find that chronic posterior urethritis and prostatitis, onanism, coitus reservans, and too frequent sexual intercourse may be considered as the four principal causative factors. Examination of these cases gives evidence that chronic catarrhal and inflammatory conditions of the prostate and of the seminal vesicles are often due to these causes. It is believed by some that, clinically, these conditions of the prostate and seminal vesicles present different pictures, varying according to their respective causes.

The clinical symptoms—and this refers to a chronic and not to an acute inflammatory state—are a burning sensation during, and an increased desire for, micturition and a sensation of burning and pressure in the bladder and perineum. Endoscopic examination shows that the colliculus seminalis may be much enlarged, and the pars prostatica chronically inflamed. In addition, an excitable sexual weakness may be present. Finger believes that the excitable weakness from sexual excess and that from coitus reservans resemble each other closely, whereas excitable weakness due to onanism resembles that due to chronic urethritis, except that it is somewhat slower in presenting itself. Clinically, the symptoms due to coitus reservans, occurring as they generally do in men of middle age or over, resemble very much the earlier symptoms of prostatic hypertrophy. In fact, any one of the four causes mentioned may, in time, become the exciting factor of prostatic hypertrophy, owing to the formation of cicatricial tissue, the result of the chronic inflammation closing up the mouths of the prostatic acini; or it may be the cause of prostatic atrophy, owing to the formation of cicatricial tissue between the acini, which compresses them, and is followed by parenchymatous atrophy. A reference to the pathology of this condition will be found under the head of Diseases of the Prostate.

Among the abundant proofs that the inflamed conditions mentioned are traceable to the four causes given are the evidences of chronic inflammation existing at the neck of the bladder; these evidences consist of the presence of shreds, lecithin bodies, and excessive numbers of leukocytes in the urine; and, as revealed by the endoscope, a chronic inflammatory condition with enlargement of the colliculus in the pars prostatica. It seems reasonable to assume that, as this chronic inflammatory condition takes place, it causes a similar condition of the nerve-endings in that portion of the body; and, that this interferes with the proper conductivity between the nerves and the spinal cord and brain, giving rise to a complication that may be termed a sexual neurasthenia. The inflammatory conditions, their causes, relation, and the symptoms they give rise to are well demonstrated.

Further, in addition to the symptoms previously cited, there are present the manifestations of general neurasthenia. Follow-

ing the stage marked by frequent pollutions and early ejaculations, a second stage generally succeeds, according to Casper, characterized by neuralgia of the lumbosacral plexus and impaired potency; this is followed by a third stage, in which the neurasthenia may extend up the spinal cord, causing a cerebrospinal neurasthenia. With this multiplicity of symptoms there are associated derangements of the circulatory and digestive apparatus.

The differential diagnosis between sexual neurasthenia and neurasthenia due to some other cause, but in which there may be disturbances of the sexual function as a symptom, is, however, extremely difficult. These cases of general neurasthenia, which are more often due to heredity, worry, or malaria than to any other factors, may be differentiated from sexual neurasthenia in the following manner:

In general neurasthenia there is no disease of the pars prostatica or but so slight an organic disturbance that it is not in itself sufficient to give rise to the condition. In these patients, as would be expected, the disease-picture is a changing one. If they are impotent or semi-impotent, there are times when normal potency alternates with excitable weakness, and these symptoms follow one another at short intervals. Sexual symptoms in these cases run parallel with the other symptoms of neurasthenia, or a certain alternation of symptoms is noticeable—as, for instance, those of sexual neurasthenia predominating one day, gastric symptoms another, and the symptoms of cerebrospinal neurasthenia another. In sexual neurasthenia, on the other hand, sexual symptoms are constantly evident, perhaps combined in greater or less degree with the general neurasthenic manifestations.

The writers have endeavored to describe briefly the symptoms and the pathology, so far as they are known up to the present time, of what may properly be termed sexual neurasthenia, which, as the reader will easily perceive, also embraces certain forms of impotence, spermatorrhea, and similar conditions.

Space does not permit a consideration of all the conditions that could properly come under the first division. Impotence due to trauma, malformations of the genital apparatus, ulceration, gan-

grene, neoplasm, small frenum, warts, and elephantiasis could all be considered in this class. It may be due to shrinking of the corpora cavernosa, in whole or in part, which may occur as the result of age. Hydrocele, epididymitis, and orchitis all belong here. Sterility may also be due to some of the above causes.

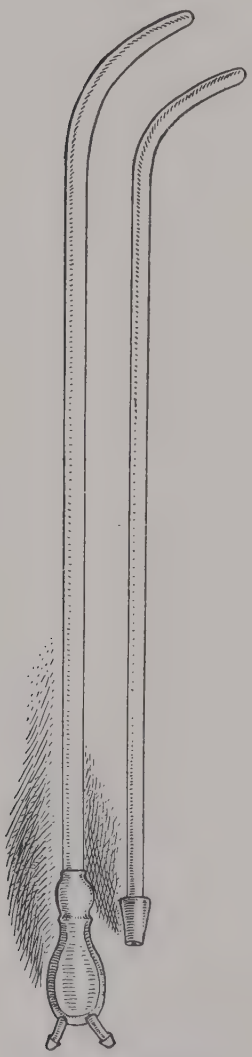


Fig. 301.—Meschung sound for application of cold.

The *prognosis* for the cure of the patients in this class is that for the cure of the inflammatory conditions, the neurasthenia, and the impotence, and is good in those cases in which the original cause can be made out and eradicated.

Treatment.—The exciting cause should be removed, the general health improved, and proper local treatment instituted for the chronic inflamed condition at the neck of the bladder if this be present. If removing the cause and building up the general health are not sufficient, mental therapeutics may do good. Some benefit may accrue from giving the patient a clear description of his condition. Tonics of iron, manganese, and phosphorus are to be prescribed. Sea-bathing, exercise in the open air, and some occupation that will divert the patient's mind from the local disturbance should be recommended.

The local treatment should be carried out with the utmost gentleness, as these neurasthenic patients are very easily irritated and react badly to any treatment that is at all heroic. The passing of a silk bougie, followed later by the Kollmann dilator, irrigations or instillations of weak solutions of silver nitrate, and prostatic massage may all be employed tentatively and their effect observed. The application of an ointment, for example, one con-

taining 1 per cent. of aristol, on a grooved sound or on a Young's ointment applicator will prove of benefit. By introducing a straight endoscope and touching the colliculus once a week with a silver nitrate solution (10 per cent.) applied by means of a cotton-wound applicator, good may be accomplished. An instrument known as the psychrophore, or a Meschung sound, by means of which cold can be applied to the prostatic urethra, has been recommended in the treatment of such cases by many writers. It is somewhat inconvenient to use, and probably gives no better results than can be obtained from the use of the other methods previously mentioned. Above all, sexual continence or the regulation of the sexual life, as by marriage, is to be recommended.

If the functional disturbances are due to new-growths, ulceration, gangrene, too short a frenum, or other malformation, proper surgical treatment should be instituted. Sterility is not infrequently due to the past effects of a double epididymitis, but cases due to malformation have also occurred. Gyurkowchty's examination of 6000 young men, however, showed malformations present in only three.

Where a double orchi-epididymitis, causing a stenosis of the vas deferens, is responsible for sterility, an operation for its relief may be performed; this is done by anastomosing the vas deferens by an incision about three-fourths of an inch long with the back of the epididymis. This operation is difficult to perform on account of the small caliber of the vas deferens. A small buttonhole may be made in the vas, and a suture run through each angle, uniting with the incision in the epididymis. This operation has been performed in comparatively few cases, and complete reports concerning it have not been published; it seems, however, to have been successful in some cases.

It should be remembered that in some cases a previous organic lesion of the deep urethra may have been treated and cured, and yet later, for some reason, a general neurasthenia may develop. Such patients would belong to class 2, and should be referred to the family physician or to the neurologist for treatment.

Class 2.—As in this class of patients the disorder is due to a general defect or to a disturbance of the nervous system, it embraces those in whom the functions of the sexual apparatus

are disorganized because of some diseased condition organically independent of the sexual organs. General acute diseases, such as typhoid fever and pneumonia, or the chronic general diseases, such as nephritis, malaria, and conditions in which there is involvement of the spinal cord, as locomotor ataxia, myelitis, and the like, may interfere with the sexual functions. This is especially evident in certain drug habits, as in alcoholism, morphinism, and the like. Certain psychic causes would also come under this head, *e. g.*, psychic paresthesia, which may provoke seminal emissions without erection. Preponderance of psychic inhibition, insufficient stimulation of excitable centers, or sudden disturbances of reflex action may all tend to disturb the sexual function. The various forms of intoxication, as, for example, diabetes and lead-poisoning, could be considered as coming under this head, and may tend to cause functional disturbances or impotence, and cause the libido to be retained.

It is very interesting to observe how carefully and dogmatically some writers, particularly the Germans, have classified these various causes, which, after all, are only conjectural, attributing impotence to too small a center in the brain to cause the proper reflex activity that gives rise to erection, or to too weak a stimulation in the brain center supposed to regulate the sexual act. Although, as previously stated, the treatment of this class of patients should properly be relegated to the family physician or the neurologist, the surgeon should, nevertheless, be sufficiently familiar with mental and nervous diseases to be able to differentiate them from organic disease of the sexual apparatus. The mistake is frequently made of overlooking organic diseases of the spinal cord.

Treatment will necessarily consist primarily in the elimination of the causative factors.

Class 3.—This being a mixed class, in which there is a combination of general or mental disorders with the presence of actual lesions in the genito-urinary tract, the diagnosis is particularly difficult. There may be two or three different factors at work, and these belong in class 1 or 2. As fairly representative of this third class may be mentioned the not uncommon case of a man with a slight chronic posterior urethritis, whose mind is immovably fixed on his urethra, to the exclusion of all else; or that of a man

suffering from some general disease, such as neurasthenia, due to malaria, lead-poisoning, or the early stages of tuberculosis. Such a patient generally presents evidences of some slight organic disease, most often of the deep urethra, and this is not infrequently overtreated and too little attention given to the constitutional disorder. On the other hand, when the treatment is undertaken, enough attention may not be given to the symptoms in the urinary tract, all the efforts being directed toward improving the patient's general condition.

In this class of cases the *prognosis* as regards the recovery of loss of function of the sexual apparatus is dependent upon so many factors that no general statement can be made. In these patients, more than in those of the other two classes, success is largely the result of good judgment and skilful treatment by surgeon or physician. When the varying causes that play a part in the disturbance can be ascertained, the physician may be able to institute a course of treatment that will restore the normal condition, whereas the surgeon, confined to a narrower field, might be unable to accomplish equal results.

Obviously, no definite general plan of *treatment* can be laid down for patients of this class. The case must be treated as a whole, attention being first directed to the dominant conditions. Incidentally all local lesions of an irritative character should receive proper local or general treatment; there is, however, no more severe test of the physician's judgment and ability than is demanded for the successful management of these cases.

INDEX

Abdominal nephrectomy, 305
Abscess of Cowper's glands, 474
  treatment, 475
  of Littré's glands after urethritis, 421
  of prostate, 557
    treatment, 557
  perinephritic, 189
  peri-urethral, in female, 492
Absence of kidney, 247
Acetone in urine, 118
Acid, phosphoric, in urine, 116
  sulphuric, in urine, 116
  uric, 115, 158
  urine, substances in, 125
Actinomyces fungi in urine, 128
Adenocarcinoma of bladder, 353
Adenocytoma, papillomatous, of testicle, 609
Adenoma of kidney, 259
  of testicle, 610
Afferent artery, 154
After-care, postoperative, 90
Albarran's incision for exploration of kidney, 292
    for removing prostate, 579
    for repairing bladder wall after suprapubic cystotomy, 357
    for suturing urethra, 474
Albuminuria, 116
  exophthalmos in, 175
Alexander's operation for hypertrophy of prostate, 564
Alkaline urine, substances in, 127
Amaurosis, uremic, 177
Amblyopia, uremic, 177
Ammonio-magnesium phosphate in urine, 127
Ammonium urate in urine, 127
Amputation of penis, 509
    in continuity, 511
Amyloid casts in urine, 124
Anastomosis, lateral, of ureters, 334
      Israel's operation, 334
  rectal, of ureters, 347
Anemia in nephritis, 167
    treatment of, 169
  of prostate, 535
Anesthesia, 99
Anesthesia, conduction, 100
      Legueu's needles for, 103
  local, 100
  nausea after, 107
  rectal, 100
  spinal, 100
Angioma of kidney, 279
Anomalies in arterial supply of kidneys, 250
Antiformin test for tubercle bacillus in urine, 241
Anuria after operation, 108
  opening and draining pelvis of kidney for, 317
Aplasia of bladder, 344
Arnott's probe, 470
Arteria rectæ, 153
Arterial arcade of kidney, 153
  supply of kidneys, anomalies in, 250
Arteries, helicine, 515
Artery, afferent, 154
  efferent, 154
Atony of bladder, 346
    treatment, 346
Atrophy of testicle, 600
    treatment of, 634

Bacillus, colon, in urine, 128
  green-pus, in urine, 127
  proteus, in urine, 128
  smegma, in urine, 128
  timothy hay, in urine, 128
  tubercle, in urine, 128
      antiformin test for, 241
Bacteria, Gram's method of staining, 131
  in urine, 127
    as cause of suppurative nephritis, 188
Bacterial content in gonorrheal urethritis, 135
  in simple urethritis, 133
Balanitis præputialis, 514
Bandage, scrotal, 620, 621
    method of applying, 98
    triangular, method of forming, 98

Beck's operation for hypospadias of glans, 504
for scrotal hypospadias, 507
Bertini's columns, 152
Bessel-Hagen's operation for plastic repair of denudations of skin of penis, 498
Bevan's operation for inguinal retention of testicle, 631
Bierhoff cystoscope, 70
modification of Nitze-Albarran cystoscope, 75
supports for legs in cystoscopy, 65
Bigelow's evacuator, 368
lithotrite, 368
Bile-pigments in urine, 119
Bismuth in *x*-ray diagnosis of bladder diseases, 52
Bistoury, Gouley's 471
Bladder, abnormities in shape and size of, 345
adenocarcinoma of, 353
anatomy of, 343
aplasia of, 344
atony of, 346
treatment, 346
blood-supply of, 344
carcinoma of, 353
continuous catheterization of, in Bright's disease, 316
curettage of, in chronic cystitis, 375
dilatation of, 345
diseases of, 344
diagnosis, 355
treatment, 355
distortion of, 345
diverticulum of, 345, 410
epithelioma of, 343
evacuator and obturator, Chismore's, 370
exstrophy of, 344
Bottomley's operation for, 402
diagnosis, 397
Harrison's operation for, 404
Maydl's operation for, 398–400
Segond's operation for, 401–403
Sonnenberg's operation for, 396, 397
treatment, 397
extirpation of, total, 407
fibroma of, 352
foreign bodies in, diagnosis of, 395
cystoscopic appearances in, 60
treatment of, 395
hernia of, 408
diagnosis, 408
treatment, 409
inflammation of, 348. See also *Cystitis*.
injuries of, diagnosis, 404
treatment, 405
Bladder, irrigation, continuous, after operation, 111
malformations of, acquired, 346
congenital, 344
mucous coat of, 344
muscular coat of, 343
myoma of, 352
myxoma of, 352
nerve-supply of, 344
papilloma of, 351
pathology of, 344
perforations of, 346
physiology of, 343
puncture of, 374
resection of, 391, 392
rupture of, 345, 405
diagnosis, 405
treatment, 406
sarcoma of, 354
serous coat of, 343
stone in, cystoscopic appearances in, 68
diagnosis of, 364
litholapaxy for, 368
remarks on removal of, 374
suprapubic cystotomy for, 376
lateral incision, 384
symptoms of, 365
treatment of, 364
submucous coat of, 344
syphilitic disease of, 350, 354
cystoscopic appearance in, 66
tumors of, 350
cystoscopic appearances in, 68
diagnosis, 388
innocent, 351
malignant, 352
treatment, 388
ulcers of, 395
wounds of, diagnosis, 404
treatment, 405
Blindness, uremic, 177
Blood in acute nephritis, 167
in chronic interstitial nephritis, 168
in diseases of kidney, 163
in nephritis, 166, 167
in new-growths of kidney, 167
in parenchymatous nephritis, 167
in tubercular nephritis, 166
in uremia, 168
Blood-casts in urine, 124
Blood-corpuscles, red, in urine, 124
Blood-pressure and pulse chart, 172
in diseases of kidney, 170
Blood-supply of bladder, 344
of kidney, 150
minute anatomy, 153
of testicles and epididymis, 599
Bottomley's operation for exstrophy of bladder, 402
Bougie, Greene's, 463

Bougies, 37
à boule, 39
filiform, 37
Bowels, condition of, in examining, 20
Bowman's capsule, 147, 152
Bridge for support of scrotum in epididymitis, 619
Bright's disease, 194
acute, pathology of, 195
symptoms of, 206
treatment of, 212
chronic degenerative type of, pathology, 205
diagnosis of, 208
food in, 221
personal hygiene in, 218
treatment of, 217
continuous catheterization of bladder in, 316
course of, 206
diagnosis of, 206
operative treatment of, 316
pathology of, 194
prognosis of, 210
symptoms of, 206
treatment of, 212
surgical, 316
Bryson's operation for hypertrophy of prostate, 568
Bubo, 500

Cachexia in cancer of prostate, 590
Calcium carbonate in urine, 127
oxalate crystals in urine, 126
Calculus in urethra, 501
prostatic, 559
renal, 268
diagnosis, 273
nephrotomy for, 302
pathology, 268
pyelotomy for, 303
symptoms, 272
treatment, 274
ureteral, 322
operations for, 341
vesical, diagnosis of, 364
litholapaxy for, 368
remarks on removal of, 374
suprapubic cystotomy for, 376
lateral incision, 384
symptoms of, 365
treatment of, 364
Calices of kidney, 152
Capsule, fibrous, of kidney, 151
of Bowman, 147
Caput gallinaginis, 532
Carcinoma, chimney-sweep's, 610
of bladder, 353
of female urethra, 494
Carcinoma of kidney, 280
of penis and gumma of penis, differentiation, 511
of prostate, 588
age occurring, 590
cachexia of, 590
frequency of, 588
hematuria in, 592
pain in, 591
physical examination in, 592
prognosis, 594
treatment of, 594
curative, 595
palliative, 594
preventive, 594
of testicle, 610
Caruncles of female urethra, 495
Castration, 628
Casts, amyloid, in urine, 124
blood-, in urine, 124
epithelial, in urine, 124
fatty, in urine, 124
granular, in urine, 124
hyaline, in urine, 124
in urine, 123
pus-, in urine, 124
waxy, in urine, 124
Catarrhal cystitis, 349
urethritis, acute, 417
chronic, 417
Catheter after operation, 110
Hutchinson's, for applying ointments to urethra, 439
life, 565
Malécot, 27
Mercier's, 460
bicoudé, 35
coudé, 35
Pezzer, 37
Ultzmann's, 43
Catheterization, 43
continuous, of bladder, in Bright's disease, 316
method of passing instrument in, 44
of ureters, 70
with reverse cystoscope, 75
with ureteral catheter cystoscope of straight type, 72
Catheters, 33
Cells, epithelial, in gonorrheal urethritis, 134
in simple urethritis, 132
pus-, in gonorrheal urethritis, 134
in urine, 121
sustentacular, 597
Cercomonas intestinalis in urine, 128
Cerebral hemorrhage, postoperative, 106
Cervical secretion, examination of, 143
Chancre of penis, 500
Chancroid of penis, 500

Chemic composition of urine, 157
Chimney-sweep's cancer, 610
Chismore's bladder evacuator and obturator, 370
evacuating lithotrite, 369
Chlorids in urine, 115
Chondroma of testicle, 610
Chyluria, 119
Circumcision, 516
in adult, 517
Cloudy urine, 31
Collecting tubule of kidney, 153
Colon bacillus in urine, 128
Columns of Bertini, 152
of Sertoli, 597
Compensation in renal disease, 168
Compensatory hyperplasia of kidney, 161
Complement-fixation in gonorrhea, 144
Conduction anesthesia, 100
Legueu's needles for, 103
Condyloma of female urethra, 495
Conjugate sulphates in urine, 116
Conjunctiva, edema of, in renal diseases, 175
Conjunctivitis, gonorrheal, 442
Convoluted tubules, 597
Corpora cavernosa, 392
Corpus highmorianum, 596
spongiosum, 513
Corpuscles, red, in urine, 120
Cortex of kidney, 151
Cowperitis, urethral exudate in, 139
Cowper's glands, 415
abscess of, 474
treatment, 475
Credé's treatment of ophthalmia neonatorum, 445
Crisis, Dietl's, 252
Crura of penis, 412
Cryptorchidism, 600
Crystalline deposits in urine, 125
Crystals, calcium-oxalate, in urine, 126
Curettage of bladder in chronic cystitis, 375
Cylindroids, in urine, 123
Cystic kidney, 248
tumors of testicle, 609
parasitic, of testicle, 609
Cystin in urine, 126
Cystitis, 348
acute, cystoscopic appearances in, 66
diagnosis of, 356
symptoms of, 356
treatment of, 356
catarrhal, 349
chronic, cystoscopic appearances in, 66
Cystitis, chronic, diagnosis of, 358
treatment of, 358
curettage of bladder, 375
internal, 358
local, 359
diagnosis of, 358
etiology of, 348
gonorrheal, 356
non-tubercular ulcerative, cystoscopic appearances in, 59
phlegmonous, 350
purulent, 349
treatment of, 356
tubercular, 350
cystoscopic appearances in, 68
diagnosis of, 361
treatment of, 362
Cystoscope, Bierhoff's, 70
Lewis', 71
Nitze-Albarran, Bierhoff's modification of, 75
Nitze's, 60
operating, 64
operative, 77
reverse, catheterization of ureters with, 75
Schapira, 77
universal, 63
Cystoscopic appearances, 66
in acute cystitis, 66
in chronic cystitis, 66
in enlargement of prostate, 69
in foreign bodies in bladder, 68
in non-tubercular ulcerative cystitis, 66
in stone in bladder, 68
in syphilis of bladder, 66
in tubercular cystitis, 66
in tumors in bladder, 68
Cystoscopy, 60
position of patient in, 63
practical, 63
Cystostomy, 385
Cystotomy, suprapubic, for removal of prostate, 574
for stone in bladder, 376
lateral incision, 384
Cysts, dermoid, of testicle, 609
hydatid, of kidney, 270
multilocular, of spermatic cord, 613
of ureter, 321
retention, of testicle, 609

Decapsulation of kidney, 315
Defects, congenital, of prostate, 533
Dermoid cysts of testicle, 609
Dietl's crisis, 252
Dilatation of bladder, 345
of female urethra, 491
treatment, 491

Dilators, Kollmann's, 457
Displaced kidney, 251
Displacements of kidney, 247
Distortion of bladder, 345
Diverticulum of bladder, 345, 410
Double pyonephrosis, 185
Drainage after operation, 109
in nephrotomy, 299

Echinococcus hooklets in urine, 128
Edebohls' incision for nephrectomy, 310
in operations on kidney, 390
method of fixation of kidney, 295
of nephropexy, 295
pad for operations on kidneys, 291
Edema of conjunctiva in renal diseases, 175
of eyelids in renal diseases, 175
Efferent artery, 154
Elephantiasis of scrotum, 613
diagnosis, 615
prognosis, 616
treatment of, 616
Embolic infarction of kidney in suppurative nephritis, 188
Encysted hydrocele of cord, treatment of, 627
Endocarditis, gonorrheal, 452
treatment, 453
Endoscope, Valentine's, 57
Endoscopy, 56
Endothelioma of testicle, 610
Epididymectomy, 627
Epididymis, anatomy of, 596
blood-supply of, 599
body of, 598
head of, 598
lymphatics of, 599
nerve-supply of, 599
tail of, 598
Epididymitis, 605
acute, 606
bridge for support of scrotum in, 619
chronic, 606
diagnosis of, 606
medicinal treatment of, 617
symptoms of, 606
Epispadias, 508
Thiersch's operation for, 508
Epithelial casts in urine, 124
cells in gonorrheal urethritis, 134
in simple urethritis, 132
Epithelioma of bladder, 353
Epithelium in urine, 121
Erythrocytes in urine, 120
Evacuator, Bigelow's, 368
Examination, caliber of urinary stream in, 21
Examination, character of urine in, 23
condition of bowels in, 20
diminished amount of urinary excretion in, 21
history of previous diseases in, 24
incontinence of urine in, 23
inspection in, 25
instrumental, 32
of kidney, 70
methods of, 17
microscopic, of urine, 119
micturition in, 20
of kidneys for diagnostic purposes, 288
of prostate, 28
of secretions, 30
of urethral exudate, 128
of urine, 112
of vagina, 20
physical, 26
questions in, 17–19
sexual life in, 25
urethral discharge in, 20
urinary retention in, 23
Exophthalmus in albuminuria, 175, 176
Experimental polyuria test for permeability of kidney, 81
Exploration of kidney, Albarran's incision for, 294
operations for, 291
postmortem incision for, 294
Exstrophy of bladder, 344
Bottomley's operation for, 402
diagnosis, 397
Harrison's operation for, 404
Maydl's operation for, 398–400
Segond's operation for, 401–403
Sonnenberg's operation for, 396, 397
treatment of, 397
Extirpation of bladder, total, 407
Exudate, examination of, from female genitals, 142
urethral, examination of, 128
in chronic gonorrheal urethritis, 136
in Cowperitis, 139
in gonorrheal urethritis, 133
in prostatitis, 137
in simple urethritis, 132
in vesiculitis, 138
purulent, 129
Eye, gonorrhea of, from urethritis, 442
prognosis, 443
symptoms, 443
treatment, 443
hemorrhage of, in renal diseases, 175
Eyelids, edema of, in renal diseases, 175

FAT in urine, 119
Fatty casts in urine, 124
Female genitals, examination of secretions and exudates from, 142
Fenwick's operation of suprapubic enucleation of prostate, 576
Fibroma of bladder wall, 352
of kidney, 278
of prostate, 587
of testicle, 610
polypoid, of female urethra, 496
Fibrous capsule of kidney, 151
Filaria sanguinis hominis in urine, 128
Filiform bougies, 37
Fistula of kidney, operation for, 313
of ureter, 324
perirenal, operation for, 313
urethral, in pendulous urethra, operation for, 479
operations for, 479
perineal, operations for, 480
urethrorectal, diagnosis, 482
operations for, 481
prognosis, 482
treatment, 482
local, 483
operative, 484
palliative, 483
Tuttle's operation for closure of, 484
urethrorectoperineal, diagnosis, 482
operations for, 481
prognosis, 482
treatment, 482
local, 483
operative, 484
palliative, 483
Floating kidney, 250
fixation of, 294
Forceps, Thompson's urethral, 501
Foreign bodies in bladder, cystoscopic appearances in, 68
diagnosis of, 407
treatment of, 407
in urethra, 501
Formaldehyd sterilizer, 92
Fossa navicularis, 416
Fractures of penis, 499
Fragments of tumors in urine, 122
Freyer's method of removing prostate, 577
tube, 383
Fulguration, 78
Fuller's incision for removal of seminal vesicles, 526, 528
Fungi, actinomyces, in urine, 128
Fusion of kidneys, 247

GENITALS, female, examination of secretions and exudates from, 142
Genito-urinary system, neuroses of, 640
prognosis, 644, 647
treatment, 644, 646, 647
Geographic conditions in examination, 24
Gerachty and Rowntree's test for permeability of kidney, 82
German method of abortive treatment of urethritis, 429
Gersuny and Witzel's operation for inguinal retention of testicle, 633
Glands, Cowper's, 415
abscess of, 474
treatment, 475
Littré's, 416
abscess of, after urethritis, 421
Tyson's, 414
Glans penis, 413
Glass syringes, 42
tests for locating seat of urethritis, 31, 425
Globus major, 598
Glomerulus, 148
of kidney, 154
Goldhorn's stain for spirochæta pallida, 145
Goldsmith irrigation urethrocystoscope, 60
Gonococcus, biologic characteristics of, 418
in gonorrheal urethritis, 134
in urine, 127
vaccine treatment of gonorrheal rheumatism and epididymitis, 451
Gonorrhea of eye from urethritis, 442
prognosis, 443
symptoms, 442
treatment, 443
of mouth from urethritis, 442
of rectum from urethritis, 442
Gonorrheal conjunctivitis, 442
cystitis, 356
endocarditis, 452
treatment, 453
iritis, 446
rheumatism, 447
causes, 447
course, 448
diagnosis, 449
prognosis, 449
treatment, 450
urethritis, 417. See also *Urethritis*.
Gorget, Teale's, 457
Gouley's bistoury, 471
points of whalebone guides, 462
sound and guide, 461
Gram-negative organisms, 132
Gram-positive organisms, 132
Gram's method of staining bacteria, 131

Granular casts in urine, 124
Gravity, specific, of urine, 113
Greene and Brooks' abortive treatment of urethritis, 428
Greene's bougie, 463
Green-pus bacilli in urine, 127
Gumma of kidney, 245
of penis and cancer of penis, differentiation, 511
Guyon's tube, 383

Harrison's operation for exstrophy of bladder, 404
Hay bacilli, timothy, in urine, 128
Hayden-Janet syringe, 42
Helicine arteries, 413
Hematoma of spermatic cord, 613
treatment, 613
Hematuria in cancer of prostate, 592
Hemorrhage, cerebral, after operations, 106
in nephrectomy, 310
of eye in renal diseases, 175
Henle's ascending loop, 153
descending limb, 153
loop, 153
Hernia of bladder, 408
diagnosis, 408
treatment, 408
Hodgkin's disease, tumor-like masses in kidney in, 281
Horseshoe kidney, 248
Hutchinson's catheter for applying ointments to urethra, 439
Hyaline casts in urine, 128
Hydatid cysts of kidney, 277
Hydrocele, 611
acute, 612
chronic, 582
encysted, treatment of, 627
operation for, 620
tapping of, 621
Hydronephrosis, 253
acquired, 256
congenital, 255
diagnosis, 258
etiology, 254
in predisposing to suppurative nephritis, 187
pathologic anatomy, 258
results, 262
surgery of, 327
symptoms, 258
treatment, 259
Trendelenburg's operation for, 331
Hydronephrotic sac, resection of, 334
Hyperemia of prostate, 535
Hypernephroma, 281
of prostate, 587
of testicle, 610
Hyperplasia, compensatory, of kidney, 161
Hypertrophy of prostate, 537
Alexander's operation for, 568
Bryson's operation for, 568
cystoscopic appearances in, 69
diagnosis, 560
operations for, 568
pathology of, 539
symptoms of, 538, 562
treatment of, 563
operative, 568
Hypochondriasis in chronic prostatitis, 554
Hypoplasia of testicle, 599
Hypospadias, 502
of glans, Beck's operation for, 506
operations for, 505
scrotal, Beck's operation for, 506
operations for, 506
varieties, 504

Ichthyol in tubercular cystitis, 362
Incision, Albarran's, for exploration of kidney, 294
Edebohls', for nephrectomy, 310
in operations on kidney, 290
for removal of seminal vesicles, 526, 528
Israel's, in operations on kidney, 290
for nephrectomy, 310
Kocher's, for removal of seminal vesicles, 525, 527
Kraske's, for removal of seminal vesicles, 524, 527
Rydygier's modification of, 527
loin, in operations on kidney, 290
postmortem, for exploration of kidney, 294
Senn's, for removal of seminal vesicles, 526, 527
transverse, in operations on kidney, 290
von Dittel's, for removal of seminal vesicles, 525, 527
Zuckerkandl's, for removal of seminal vesicles, 525, 527
Incontinence of urine in children, 347
in examining, 23
Indican in urine, 119
Indigo-carmin test for permeability of kidney associated with ureter catheterization, 87
Infarction, embolic, of kidney, in suppurative nephritis, 188
of kidney in acute infectious diseases, 181
uric-acid, 271

Infectious diseases, acute, diseases of kidney in, diagnosis of, 183
prognosis of, 184
treatment of, 184
infarction of kidney in, 181
kidney in, 179
nephritis in, prognosis of, 183
treatment of, 182
Inflammation of bladder, 348. See also *Cystitis*.
of ureters, 321
Inguinal retention of testicle, treatment for, 631
Inspection in examination, 25
Instrumental examination, 32
of kidney, 70
Instruments, urethral, care of, 90
lubricants for, 94
sterilization of, 91
Interstitial nephritis, chronic, blood in, 168
Iritis, gonorrheal, 446
Israel's incision for nephrectomy, 310
in operations on kidney, 290
method of lateral anastomosis of ureter, 334

JANET syringe, 42
Janeway's sphygmomanometer, 170, 171

KATHETERPURINE, 95
Keetly's operation for inguinal retention of testicle, 631
Kidney, 147
absence of, 247
adenoma of, 279
Albarran's incision for exploration of, 294
anatomy of, 148
angioma of, 279
arterial arcade of, 153
supply of, anomalies in, 250
blood-supply of, 150
minute anatomy, 153
calices of, 152
carcinoma of, 280
collecting tubule of, 153
compensatory hyperplasia of, 161
congenital lobulation of, 247
cortex of, 151
cystic, 248
decapsulation of, 315
diseases of, blood in, 163
blood-pressure in, 170
compensation in, 158
edema of conjunctiva in, 175
of eyelids in, 175
Kidney, diseases of, hemorrhage of eye in, 175
in acute infectious diseases, diagnosis of, 183
prognosis of, 184
treatment of, 184
ocular manifestations, 175
displacements of, 247, 251
distal tube of, 153
embryology of, 147
examination of, for diagnosis, 288
fibroma of, 277
fibrous capsule of, 151
fistula of, operation for, 313
floating, 250
fixation of, 294
fusion of, 247
glomerulus of, 154
gumma of, 245
horseshoe, 248
hydatid cysts of, 277
in acute infectious diseases, 179
in syphilis, 244
infraction of, in acute infectious diseases, 181
injuries of, 263
prognosis, 265
treatment, 266
instrumental examination of, 70
irregular tubule of, 153
labyrinth of, 151
lesions of, in uremia, 228
lipoma of, 278
lymphatics of, 150
malformations of, 247
congenital, 247
malposition of, congenital, 248
medulla of, 151
medullary rays of, 151
movable, 250
diagnosis of, 251
Dietl's crisis in, 252
fixation of, 294
Edebohls' method, 295
pathology of, 250
treatment, 252
myoma of, 279
new-growths of, blood in, 167
operations for exploration of, 291
operations on, 288
papilloma of, 279
pelvis of, 152
lavage of, 318
permeability of, associated with ureter catheterization, 86
indigo-carmin test for, 87
water test, 87
experimental polyuria test for, 81
methylene-blue test for, 81

Kidney, permeability of, nitrogen test, 81
phenolsulphone-phthalein test for, 82
phloridzin test for, 85
tests for, 80
physiology of, 154
postmortem incision for exploration of, 294
proximal convoluted tubule of, 153
pyramids of, 152
rhabdomyoma of, 279
sarcoma of, 280
second tube of, 153
sensory nerve-supply of, 151
spiral tube of, 153
stone in, 268
diagnosis, 273
nephrotomy for, 302
pathology, 268
pyelotomy for, 303
symptoms, 272
treatment, 274
suppurative diseases of, polynuclear leukocytosis in, 166
surgery of, 288
tuberculosis of, 237. See also *Tuberculosis of kidney.*
tumor-like masses in, in lymphosarcoma, 281
tumors of, 289
diagnosis, 283
nephrectomy in, 314
treatment, 287
wounds of, 261
prognosis, 261
treatment, 262
Kinks of ureters, 262
Knife, Rand's, 469
Kocher's incisions for removal of seminal vesicles, 525, 527
Kollmann's dilators, 457
method of diagnosing urethritis, 425
probe, 58
Kraske's incision for removal of seminal vesicles, 524, 527
Rydygier's modification of, 524, 527
Küster's operation for stricture of ureter, 331

Labyrinth of kidney, 151
Lacunæ of Morgagni, 416
Lavage of pelvis of kidney, 318
Legueu's needles for conduction anesthesia, 103
Leucin in urine, 126
Leukocytes in urine, 121
Leukocytosis, polynuclear, in suppurative diseases of kidney, 166
Lewis' dilating bulb, 71
double ureter-cystoscope, 71
Lipoma of kidney, 278
Litholapaxy, 368
technic of, 370
Lithotrite, Bigelow's, 368
Chismore's evacuating, 369
Littré's glands, 416
abscess of, after urethritis, 523
Lobulation, congenital, of kidneys, 247
Local anesthesia, 100
Löffler's methylene-blue stain, 130
Loin incision in operations on kidney, 290
Loop of Henle, 153
Lubricants for urethral instruments, 94
Lymphatics of kidney, 150
of testicles and epididymis, 599
Lymphosarcoma, tumor-like masses in kidney in, 251

Maisonneuve's urethrotome, 464
Malécot catheter, 37
Malformations, congenital, of female urethra, 488
of bladder, acquired, 345
congenital, 344
of kidney, 247
congenital, 247
of ureters, 321
Malignant tumors of bladder, 352
of female urethra, 494
treatment, 495
of testicle, 610
Malpighian body, 147, 152
Malposition, congenital, of kidneys, 248
Massage, prostatic, in chronic prostatitis, 550
Maydl's operation for exstrophy of bladder, 398–400
Mayo attachment to surgical table for operations on kidney, 291
Meatotome, Otis', 454
Meatotomy, 453
Meatus urinarius, 416
stricture of, from urethritis, 453
Mediastinum testis, 596
Medulla of kidney, 151
Medullary rays of kidney, 151
Membranous urethra, anatomy of, 411
Mendelism, 18
Mercier's bicoudé catheter, 35
catheter, 460
coudé catheter, 35
Meschung's sound, 644
Mesonephros, 147
Metamorphosis, fatty, of testicle, 601
Metanephros, 147

Methylene-blue stain, Löffler's, 130
test for permeability of kidney, 81
Micro-orchia, 599
Microscopic examination of urine, 119
Micturition in examining, 20
Monorchidism, 600
Morgagni, lacunæ of, 416
Mouth, gonorrhea of, from urethritis, 442
Movable kidney, 250
diagnosis of, 251
Dietl's crisis in, 252
fixation of, 294
Edebohls' method, 295
pathology of, 250
treatment, 252
Mucus in urine, 121
Murphy's method of proctoclysis after operation, 108
Myoma of bladder, 352
of kidney, 279
of prostate, 578
Myxoma of bladder, 352

Nausea after anesthesia, 107
Nephrectomy, 303
abdominal, 305
by morcellement, 313
Edebohls' incision for, 310
hemorrhage in, 310
in tumors of kidney, 314
Israel incision for, 310
partial, 306
remarks on, 309
transperitoneal, 305
Nephritis, acute, blood in, 167
treatment of, 212
anemia in, 167
treatment of, 169
blood in, 167
chronic inflammatory variety of, pathology, 202
interstitial, blood in, 168
treatment of, 217
in acute infectious diseases, prognosis of, 183
treatment of, 182
ophthalmoplegia in, 176
parenchymatous, blood in, 167
retinitis in, 176, 177
suppurative, 184
bacteria in urine as cause of, 178
causes of, 184
diagnosis of, 190
embolic infarction of kidney in, 188
hydronephrosis in predisposing to, 187
treatment of, 193
treatment of, 212
Nephritis, tubercular, blood in, 166
Nephropexy, 294
Edebohls' method, 295
Nephrostomy, 300
Nephrotomy, 299
drainage in, 299
for stone in kidney, 302
Nerve-supply of bladder, 344
of testicles and epididymis, 599
sensory, of kidneys, 151
Neurasthenia in chronic prostatitis, 554
sexual, 643
Neuroses of sexual organs, 640
prognosis of, 643, 647
treatment of, 642, 643, 647
New-growths of kidney, blood in, 150
Nitrogen test for kidney permeability, 81
Nitze-Albarran cystoscope, Bierhoff's modification of, 75
Nitze's cystoscope, 60
operating cystoscope, 64
Nodules, saddle-shaped, of penis, 499

Occupational diseases in examination, 24
Ocular manifestations of renal diseases, 175, 178
Operations, after-care of patient, 90
anuria after, 108
catheter after, 110
cerebral hemorrhage after, 106
continuous bladder irrigation after, 111
drainage after, 109
Murphy's method of proctoclysis after, 108
pneumonia after, 107
preparation of patient for, 96
Operative cystoscopes, 77
Ophthalmia, gonorrheal, 442
neonatorum, 445
Ophthalmoplegia in nephritis, 176
Orchi-epididymitis from strain of spermatic cord, 607
Orchitis, acute, 601
etiology of, 601
pathologic anatomy of, 602
symptoms of, 602
chronic, 603
syphilitic, 605
symptoms of, 605
tubercular, 604
medical treatment of, 618
symptoms of, 605
Osteoma of testicle, 607
Otis' meatotome, 454
metallic bougie à boule, 39
urethrometer, 40, 465

PAIN in cancer of prostate, 591
Papilloma of bladder, 351
of kidney, 279
Papillomatous adenocystoma of testicle, 609
Paraphimosis, 511
treatment of, 512
Parasitic cystic tumors of testicle, 609
Parenchymatous nephritis, blood in. 167
Patent urachus, 410
treatment, 411
Pelvis of kidney, 152
lavage of, 318
Penis, 497
amputation of, 509
in continuity, 511
anatomy of, 412
carcinoma of, and gumma of penis, differentiation, 511
chancre of, 500
chancroid of, 500
crura of, 412
denudations of skin of, Bessel-Hagen's operation for plastic repair of, 498
Reich's operation for plastic repair of, 498
fractures of, 499
growths of, 499
gumma of, and cancer of penis, differentiation, 511
injuries of, 497
treatment, 497
saddle-shaped nodules of, 499
tumors of, 499
ulcerations on, 500
wounds of, 497
treatment, 497
Perforations of bladder, 346
Perineal hypospadias, operations for, 507
urethral fistula, operations for, 480
Perinephritic suppuration, 189
Perirenal fistula, operations for, 313
Peri-urethral abscess in female, 492
Permeability of kidney, experimental polyuria test for, 81
methylene-blue test for, 81
phenolsulphone-phthalein test for, 82
phloridzin test for, 85
tests for, 80
Permeable urachus, 344
Pezzer's catheter, 37
Phenolsulphone-phthalein test for permeability of kidney, 82
Phimosis, 514
treatment of, 514
Phlegmonous cystitis, 350
Phloridzin test for permeability of kidney, 85
Phosphate, ammonio-magnesium, in urine, 127
Phosphates, amorphous, in urine, 126
Phosphorus in urine, 116
Pigments, bile-, in urine, 119
Pneumonia after operations, 107
Polynuclear leukocytosis in suppurative diseases of kidney, 166
Polypoid fibroma of female urethra, 496
Polyuria test, experimental, for permeability of kidney, 81
Postmortem incision for exploration of kidney, 294
Potassium, urates of, in urine, 125
Preformed sulphates in urine, 116
Preparation of patient for operation, 96
on testicle, 96
for suprapubic section, 97
Probe, Arnott's 470
Kollmann's, 58
Proctoclysis, Murphy's method, after operation, 108
Pronephros, 147
Prostate, abscess of, 557
treatment, 557
anatomy of, 532
anemia of, 535
calculus of, 47
carcinoma of, 588. See also *Carcinoma of prostate.*
congenital defects of, 533
diseases of, diagnosis and treatment, 546
examination of, 28
fibroma of, 587
hyperemia of, 535
hypernephroma of, 587
hypertrophy of, 537. See also *Hypertrophy of prostate.*
injuries of, 534
myoma of, 587
physiology of, 533
removal of, partial, 386
through suprapubic opening, 574
Albarran's method, 579
Fenwick's method, 576
Freyer's method, 577
sarcoma of, 587
tumors of, 587
wounds of, 534
Prostatic massage in chronic prostatitis, 550
sinus, 414
urethra, anatomy of, 414
Prostatitis, 535
acute, 535

Prostatitis, acute, diagnosis of, 546
symptoms of, 546
treatment of, 547
chronic, 537
diagnosis of, 547
hypochondriasis in, 554
neurasthenia in, 554
prostatic massage in, 550
symptoms of, 547
treatment of, 547
urethral exudate in, 137
Proteus bacillus in urine, 128
Psychrophore, 645
Pulse in uremia, 232
Puncture of bladder, 374
Purulent cystitis, 349
urethral discharges, 140
urethritis, acute, 418
Pus, green, bacilli of, in urine, 138
Pus-casts in urine, 124
Pus-cells in gonorrheal urethritis, 134
in urine, 121
Pyelography, 52
dangers of, 54
thorium in, 52
value of, 54
Pyeloplication and ureter correction, 336
Pyelotomy for stone in kidney, 303
Pyonephrosis, double, 185
Pyramids of kidney, 152

Radium treatment of bladder tumors, 285
Rand's tunneled knife, 469
Reaction of urine, 114
Rectal anastomosis of ureters, 337
anesthesia, 100
Rectum, gonorrhea of, from urethritis, 442
Red blood-corpuscles in urine, 120
Reich's operation for plastic repair of denudations of skin of penis, 498
Renal tissue, 152
Resection of bladder, 391, 392
of hydronephrotic sac, 334
of urethra, 476
Rete testis, 597
Retention cysts of testicle, 609
inguinal, of testicle, treatment for, 631
of urine after operation, 108
from urethritis, treatment, 459
Retinitis in nephritis, 166, 167
Rhabdomyoma of kidney, 279
Rheumatism, gonorrheal, 447
causes, 447
course, 448
diagnosis, 449
Rheumatism, gonorrheal, prognosis, 450
treatment, 450
Röntgen rays, value in diagnosis, 51
Rowntree and Gerachty's test for permeability of kidney, 82
Rupture of bladder, 345, 405
diagnosis, 405
treatment, 406
of urethra, 472
diagnosis, 473
treatment, 473
Rydygier's modification of Kraske's incision for removal of seminal vesicles, 524, 527

Saddle-shaped nodules in penis, 499
Salvarsan, effect of, on kidney, 246
Sarcoma of bladder, 354
of female urethra, 495
of kidney, 280
of prostate, 587
of testicle, 610
Schapira cystoscope, 77
Scrotal bandage, 620, 621
method of applying, 98
triangular, method of forming, 97
hypospadias, operations for, 507
Scrotum, bridge for support of, in epididymitis, 619
elephantiasis of, 613
diagnosis, 615
prognosis, 616
treatment, 616
Searcher, 41
Thompson's, 41
Secretion, cervical, examination of, 143
examination of, 30
from female genitals, 142
seminal, examination of, 139
vaginal, examination of, 143
Section, suprapubic, preparation for, 97
Sediment, urinary, 120
Segond's operation for exstrophy of bladder, 401–403
Seminal irrigation and drainage of duct through vas deferens, 637
secretion, examination of, 139
vesicles, 522
diseases of duct, 522
treatment, 523
Fuller's incision for removal of duct, 526, 528
irrigation and drainage of duct through vas deferens, 637
Kocher's incision for removal of duct, 525, 527

Seminal vesicles, Kraske's incision for removal of duct, 524
Rydygier's modification of, 524, 527
Senn's incision for removal of duct, 526, 527
von Dittel's incision for removal of, 525, 527
Zuckerkandl's incision for removal of, 525, 527
Seminiferous tubules, 597
Senn's incision for removal of seminal vesicles, 526, 527
Sensory nerve-supply of kidneys, 151
Separation of urine, 79
Septum pectiniforme, 412
Sertoli, columns of, 597
Serum treatment of gonorrheal rheumatism and epididymitis, 451
Sexual life in history of patient, 25
neurasthenia, 643
organs, neuroses of, 640
prognosis, 644, 647
treatment, 644, 646, 647
Sinus pocularis, 415, 532
prostatic, 414
Skene's ducts, 487
Smegma bacillus in urine, 128
Sodium, urates of, in urine, 125
Sonnenberg's operation for exstrophy of bladder, 396, 397
Sound, Meschung, 644
Sounds, 40
Specific gravity of urine, 123, 157
Spermatic cord, hematoma of, 613
multilocular cysts of, 613
strain of, orchi-epididymitis from, 607
torsion of, 607
treatment, 607
duct, 599
Spermatids, 597
Spermatocele, 608
treatment, 608
Spermatocytes, 597
Spermatogenesis, 598
Spermatogonia, 597
Spermatorrhea, 141
Spermatozoa in urine, 123
Sphygmomanometer, Janeway's, 170, 171
Spinal anesthesia, 100
Spiral tube of kidney, 153
Spirochæta pallida, examination for, 144
Goldhorn's stain for, 145
Staff, Wheelhouse's, 470
Stain, Goldhorn's, for spirochæta pallida, 145
Gram's, for bacteria, 131
Löffler's methylene-blue, 130
Staphylococcus in urine, 127
Sterilization of urethral instruments, 91
Sterilizer, formaldehyd, 92
Stone in bladder, cystoscopic appearances in, 68
diagnosis of, 364
diagnosis of, 364
litholapaxy for, 368
remarks on removal of, 374
suprapubic cystotomy for, 376
lateral incision, 384
symptoms of, 365
treatment of, 364
in kidney, 268
diagnosis of, 273
nephrotomy for, 302
pathology of, 268
pyelotomy for, 303
symptoms of, 272
treatment of, 274
in ureter, 322
operations for, 341
Straight tubules, 597
Strain of spermatic cord, orchi-epididymitis from, 607
Streptococcus in urine, 127
Stricture of female urethra, 490, 492
diagnosis of, 490
treatment of, 490
of meatus urinatius from urethritis, 453
of ureter, 322, 324
Küster's operation for, 331
operations for, 341
of urethra from urethritis, 422, 454
location of, 455
symptoms of, 454
treatment of, 455
impassable, from urethritis, treatment, 459
Struma lipomatodes aberratæ renis, 281
Subconjunctival hemorrhage in renal diseases, 175
Sugar in urine, 117
Sulphates, conjugate, in urine, 116
preformed, in urine, 116
Sulphur in urine, 116
Supernumerary testicle, 493
Suppuration, perinephritic, 189
Suppurative diseases of kidney, polynuclear leukocytosis in, 166
nephritis, 184
bacteria in urine as cause of, 188
causes of, 184
diagnosis of, 190
embolic infarction of kidney in, 188
hydronephrosis in, predisposing to, 187

Suppurative nephritis, treatment of, 193
Suprapubic cystotomy for removal of prostate, 574
for stone in bladder, 376
lateral incision, 384
section, preparation for, 97
Sustentacular cells, 491
Syphilis, kidney in, 244
Syphilitic disease of bladder, 350, 354
ulcers of bladder, 395
orchitis, 605
symptoms of, 605
Syringe, Hayden-Janet, 42
Janet's, 42
Ultzmann's, for instillation, 43
Syringes, 42
glass, 42

Tapping of hydrocele, 622
Teal's gorget, 467
Test, antiformin, for tubercle bacillus in urine, 241
experimental polyuria, for permeability of kidney, 81
glass, for locating seat of urethritis, 31, 425
methylene-blue, for permeability of kidney, 81
phenolsulphone-phthalein, for permeability of kidney, 82
phloridzin, for permeability of kidney, 85
Testicle, adenoma of, 610
anatomy of, 596
atrophy of, 600
treatment, 634
benign tumors of, 609
blood-supply of, 599
carcinoma of, 610
chondroma of, 610
cystic tumors of, 609
defects of, 599
dermoid cysts of, 609
diseases of, pathology, 599
treatment, 617
therapeutic measures, 617
endothelioma of, 610
fatty metamorphosis of, 601
fibroma of, 610
hypernephroma of, 610
hypertrophy of, 600
hypoplasia of, 599
inguinal retention of, treatment for, 631
injuries of, treatment, 634
lymphatics of, 599
malignant tumors of, 610
nerve-supply of, 599
operations on, preparation for, 90
Testicle, osteoma of, 610
papillomatous adenocystoma of, 609
parasitic cystic tumors of, 609
retention cysts of, 609
sarcoma of, 609
supernumerary, 599
surgery of, 621
tumors of, 608
treatment, 630
wounds of, treatment, 634
Tests for permeability of kidney, 80
Thiersch's operation for epispadias, 508
Thompson's searcher, 41
urethral forceps, 499
Thorium, preparation of, for pyelography, 52
Timothy hay bacilli in urine, 128
Torsion of spermatic cord, 607
treatment, 607
Transperitoneal nephrectomy, 305
Transplantation of ureter, 336
Traumatism of female urethra, 488
treatment of, 489
of ureter, 322
Trendelenburg's operation for hydronephrosis, 331
Trichomonas vaginalis in urine, 128
Tube, distal, of kidney, 153
second, of kidney, 153
spiral, of kidney, 153
Tubercle bacillus in urine, 128
antiformin test for, 241
Tubercular cystitis, 350
cystoscopic appearances in, 66
diagnosis of, 361
treatment of, 362
nephritis, blood in, 166, 167
orchitis, 604
medical treatment of, 616
symptoms of, 605
Tuberculosis of kidney, 237
course, 238
diagnosis, 240
embolic or descending infection, 238
infection by ascending inoculation, 238
diagnosis of, 240
pathology, 237
prognosis, 242
treatment, 243
of ureter, 323
Tubule, collecting, of kidney, 153
convoluted, 597
irregular, of kidney, 153
proximal convoluted, of kidney, 153
seminiferous, 597
straight, 597
urinary, 152
Tumors, benign, of testicle, 609

Tumors, cystic, of testicle, 609
fragments of, in urine, 122
in bladder, cystoscopic appearances in, 68
innocent, of bladder, 351
of female urethra, 495
treatment, 496
malignant, of bladder, 352
of female urethra, 494
treatment, 495
of testicle, 610
of bladder, 350
diagnosis, 388
treatment, 388
of female urethra, 494
of kidney, 277
diagnosis, 283
nephrectomy in, 314
treatment, 285
of penis, 499
of prostate, 587
of testicle, 608
treatment of, 630
of ureters, 321
parasitic, cystic, of testicle, 609
Tunica albuginea, 412, 596
vaginalis, 596
vasculosa, 596
Tuttle's operation for closure of urethrorectal fistula, 484
Tyrosin in urine, 126
Tyson's glands, 414

Ulcerations of penis, 500
Ulcerative cystitis, non-tubercular, cystoscopic appearances in, 66
Ultzmann's catheter, 43
syringe for instillation, 43
Universal cystoscopes, 63
Urachus, 343
patent, 410
treatment, 411
permeable, 344
Urates of potassium in urine, 125
of sodium in urine, 125
Urea, 158
in urine, 114
Uremia, 223
blood in, 168
diagnosis of, 231
lesions of kidneys in, 228
prognosis of, 235
pulse in, 232
treatment of, 234
urine in, 232
Uremic amaurosis, 177
amblyopia, 177
Ureter, anastomosis of, latéral, 334
Israel's operation, 334
anatomy of, 320
Ureter, catheterization of, 70
tests showing permeability of kidney associated with, 86
with reverse cystoscope, 75
with ureteral catheter cystoscope of straight type, 72
cysts of, 321
diseases of, 321
diagnosis of, 325
fistula of, 324
inflammation of, 321
kinks of, 324
malformations of, 321
pathologic anatomy of, 321
physiology of, 320
rectal anastomosis of, 327
stone in, 322
operations for, 341
stricture of, 322, 224
Küster's operation for, 331
operations for, 341
surgery of, 327
transplantation of, 336
traumatism of, 322
tuberculosis of, 323
tumors of, 321
wounds of, 325
operations for, 340
Ureter-cystoscope, Lewis', 71
Ureterectomy, 341
Ureteropyeloneostomy, 332
Ureterotomy, 341
Urethra, anatomy of, 314
calculi in, 501
diseases of, 317
female, 487
anatomy of, 487
carcinoma of, 494
caruncles of, 495
condyloma of, 495
congenital malformations of, 488
dilatation of, 491
treatment, 491
examination of, 489
innocent tumors of, 495
treatment, 496
malignant tumors of, 494
treatment, 495
polypoid fibroma of, 496
sarcoma of, 495
stricture of, 490, 492
diagnosis, 490
treatment, 490
traumatisms of, 488
treatment, 489
tumors of, 494
foreign bodies in, 501
membranous, anatomy of, 415
penile portion of, anatomy, 415
prostatic, anatomy of, 414
resection of, 476

Urethra, rupture of, 472
diagnosis, 473
treatment, 473
spongy portion of, anatomy, 415
stricture of, from urethritis, 422
location of, 455
symptoms of, 454
treatment of, 455
impassable, from urethritis, treatment, 459
Urethral discharge in examining, 20
exudate, examination of, 128
in chronic gonorrheal urethritis, 136
in cowperitis, 139
in gonorrheal urethritis, 133
in prostatitis, 137
in simple urethritis, 132
in vesiculitis, 138
purulent, 129
fistula in pendulous urethra, operation for, 479
perineal, operations for, 480
forceps, Thompson's, 501
instruments, care of, 90
lubricants for, 94
sterilization of, 91
Urethritis, 417
abortive treatment of, 428
abscess of Littrè's glands after, 421
acute anterior, course of, 423
symptoms of, 423
treatment of, 433
early local, 436
catarrhal, 417
posterior, symptoms of, 424
treatment of, 434
purulent, 418
bacterial content in, 135
bacteriology of, 418
chronic anterior, symptoms of, 424
treatment of, 435
catarrhal, 417
diagnosis, 426
posterior, diagnosis, 427
symptoms of, 424
treatment of, 438
urethral exudate in, 136
complement-fixation in, 144
complications of, 441
diagnosis, 424
epithelial cells in, 134
German method of abortive treatment of, 429
glass test for locating seat of, 31, 425
gonococcus in, 134
gonorrhea of eye from, 442
prognosis, 443
symptoms, 443
treatment, 443
Urethritis, gonorrhea of mouth from, 442
of rectum from, 442
gonorrheal, bacterial content in, 135
chronic, urethral exudate of, 136
epithelial cells in, 134
gonococcus in, 134
pus-cells in, 134
urethral exudate in, 133
Greene and Brooks' abortive treatment of, 428
impassable stricture of urethra from, treatment, 459
in female, 492
treatment of, 493
Kollmann's method of diagnosing, 425
mode of infection in, 419
pathologic anatomy of, 419
pathology of, 417
pus-cells in, 134
retention of urine from, treatment, 459
simple, bacterial content in, 133
epithelial cells in, 132
urethral exudate in, 132
stricture of meatus urinarius from, 453
of urethra from, 422, 454
location, 455
symptoms, 454
treatment, 455
symptoms of, 422
treatment of, résumé, 440
urethral exudate in, 133
Young's method of diagnosing, 425
Urethrocystoscope, Goldsmith's irrigation, 60
Urethrometer, 39
Otis, 39, 40
Urethrorectal fistula, diagnosis of, 482
operations for, 481
prognosis of, 482
treatment of, 482
local, 483
operative, 484
palliative, 483
Tuttle's operation for closure of, 484
Urethrorectoperineal fistula, diagnosis of, 482
operations for, 481
prognosis of, 482
treatment of, 482
local, 483
operative, 484
palliative, 483
Urethrotome, Maisonneuve's, 464
Otis, 465
Urethrotomy, 470

Urethrotomy, external, 466
without a guide, 470
internal, 463
Uric acid, 115, 158
infarction, 271
Urinary constituents, 114
excretion, diminished amount of, in examining, 21
fever, 27
sediment, 130
stream, caliber of, 21
tubule, 152
Urine, 156
acetone in, 118
acid reaction of, 157
substances in, 125
actinomyces fungi in, 128
albumin in, 116
alkaline substances in, 127
ammonio-magnesium phosphate in, 127
ammonium urate in, 127
amorphous phosphates in, 126
amount passed, 113
amyloid casts in, 124
bacteria in, 127
as cause of suppurative nephritis, 185
bile-pigments in, 119
blood-casts in, 124
calcium carbonate in, 127
oxalate crystals in, 126
casts in, 123
cercomonas intestinalis in, 128
chemic composition of, 157
chlorids of, 115
cloudy, 31
collection of specimen of, for examination, 112
colon bacillus in, 128
color of, 157
conjugate sulphates in, 116
constituents of, 114
crystalline deposits in, 125
cylindroids in, 123
cystin in, 126
decrease in amount of, 113
echinococcus-hooklets in, 128
epithelial casts in, 124
epithelium in, 121
erythrocytes in, 120
examination of, 112
fat in, 119
fatty casts in, 124
filaria sanguinis hominis in, 128
fragments of tumors in, 126
gonococcus in, 127
granular casts in, 124
hyaline casts in, 124
in uremia, 232
incontinence of, in children, 347
Urine, incontinence of, in examining patient, 23
indican in, 119
leucin in, 126
leukocytes in, 121
microscopic examination of, 119
mucus in, 121
organized deposits in, 120
phosphorus in, 116
preformed sulphates in, 116
proteus bacillus in, 128
pus-casts in, 124
pus-cells in, 121
reaction of, 114
red blood-corpuscles in, 120
retention of, after operation, 108
from urethritis, treatment, 459
in examining, 23
operations for, 330
sediment in, 120
separation of, 79
smegma bacillus in, 128
specific gravity of, 113, 157
spermatozoa in, 123
staphylococcus in, 127
streptococcus in, 127
sugar in, 117
sulphur in, 116
timothy hay bacillus in, 128
trichomonas vaginalis in, 128
tubercle bacillus in, 128
antiformin test for, 241
tyrosin in, 126
urates of potassium in, 125
of sodium in, 125
urea in, 114
uric acid in, 115
waxy casts in, 114
Urorrhea, 142
Uterus masculinus, 532

Vaccine treatment, gonococcus, of gonorrheal rheumatism and epididymitis, 451
Vagina, examination of, 30
Vaginal secretion, examination of, 143
Valentine's endoscope, 57
irrigating outfit, 436
Varicocele, 610
treatment of, 635
Vas deferens, 599
irrigation and drainage of seminal duct and vesicle through, 637
Vasa efferentia, 598
Verumontanum, 415
Vesicles, seminal, 522
diseases of, 522
treatment, 523
Fuller's incision for removal of, 526, 528

Vesicles, seminal, irrigation and drainage of, through vas deferens, 404
Kocher's incision for removal of, 525, 527
Kraske's incision for removal of, 524, 527
Rydygier's modification of, 524, 527
Senn's incision for removal of, 526, 527
von Dittel's incision for removal of, 525, 527
Zuckerkandl's incision for removal of, 525, 527
Vesiculitis, 523
treatment of, 523
urethral exudate in, 138
Voelcher and Joseph's indigo-carmin test, 87
von Dittel's incision for removal of seminal vesicles, 521, 527

WATER test for permeability of kidney associated with ureter catheterization, 86
Waxy casts in urine, 124
Wheelhouse's staff, 470
Wounds of bladder, diagnosis of, 404
treatment of, 405
of kidney, 261
prognosis, 261
treatment, 262
of penis, 497
treatment, 497
of prostate, 534
of testicle, treatment of, 634
of ureter, 324
operations for, 340

X-RAY, value of, in diagnosis, 51

YOUNG'S method of diagnosing urethritis, 425

ZUCKERKANDL'S incision for removal of seminal vesicles, 525, 527

SURGERY

and

ANATOMY

W. B. SAUNDERS COMPANY

WEST WASHINGTON SQUARE PHILADELPHIA
9, HENRIETTA STREET COVENT GARDEN, LONDON

Elsberg's Surgery of Spinal Cord

Surgery of the Spinal Cord. By CHARLES A. ELSBERG, M. D., Professor of Clinical Surgery, New York University and Bellevue Hospital Medical School. Octavo of 330 pages, with 153 illustrations. Cloth, $5.00 net. **Published July, 1916**

There is no other book published like this by Dr. Elsberg. It gives you in clear definite language the diagnosis and treatment of all surgical diseases of the spinal cord and its membranes, illustrating each operation with original pictures. Because it goes so thoroughly into symptomatology, diagnosis, and indications for operation this work appeals as strongly to the general practitioner and neurologist as to the surgeon.

Cullen on the Umbilicus

Embryology, Anatomy, and Diseases of the Umbilicus. By THOMAS S. CULLEN, M. B., Associate Professor of Gynecology, Johns Hopkins University. Octavo of 680 pages, with 269 illustrations. Cloth, $7.50 net; Half Morocco, $9.00 net. **Published May, 1916**

In Dr. Cullen's new work you get chapters on embryology, anatomy, infections in the newborn, hemorrhage, granulation tissue at the umbilicus, umbilical polypi, gastric mucosa at the umbilicus, Meckel's diverticulum, intestinal cysts, patent omphalomesenteric duct, prolapsus of the bowel, concretions, abscess, Paget's disease, diphtheria, syphilis, tuberculosis, atrophy, fecal fistula, hypertrophy, angioma, lymphocele, connective-tissue growths, dermoids, sweat-glands, abdominal myomata, papilloma, adenomyoma, cancer, sarcoma, hernia, exstrophy of the bladder, urachus and its diseases, acquired urinary fistula, etc., etc.

Albee's Bone-Graft Surgery

Bone-graft Surgery. By FRED H. ALBEE, M. D., Professor of Orthopedic Surgery at the New York Post-graduate Medical School. Octavo of 417 pages, with 329 text-illustrations and 3 colored plates. Cloth, $6.50 net; Half Morocco, $8.00 net. **Published November, 1915**

ORIGINAL

This book presents Dr. Albee's original applied technic for bone-graft work. The successful outcome of any procedure to restore the skeletal architecture depends not only upon a proper operative technic, but in many cases in a greater degree upon the skill with which the postoperative external fixation dressing is applied and in the convalescent management of the case. Dr. Albee here gives you his own successful technic and his own methods of dressing and management, all illustrated with original pictures.

Dr. Albee is a firm believer in the autogenous graft, and in making it he uses the most improved instruments and tools, all of which are *shown* you, and their use in actual work. This is the only book going fully into this important qnestion of bone surgery, a field of surgical endeavor that is attracting pronounced attention over the entire surgical world.

Smithies and Ochsner's Cancer of the Stomach

Cancer of the Stomach. By FRANK SMITHIES, M. D., Gastro-enterologist to Augustana Hospital, Chicago. With a chapter on the *Surgical Treatment of Gastric Cancer*, by ALBERT J. OCHSNER, M. D., Professor of Clinical Surgery, University of Illinois. Octavo of 500 pages, illustrated. Cloth, $5.75 net. **Published January, 1916**

A STUDY OF 921 CASES

This work gives you the information gleaned from a study of 921 operatively and pathologically demonstrated cases of gastric cancer.

This new work is the first monograph upon this subject for more than a decade, and represents some ten years' study of cases at the University Hospital of Ann Arbor, The Mayo Clinic, and the Augustana Hospital of Chicago. The wonderful advances made within this time are of the greatest importance to the clinician, the pathologist, and the surgeon. Dr. Smithies presents these advances in a most practical way. The chapter on *Operative Treatment*, by Dr. Ochsner, gives you the most approved and successful technic, illustrating the various operations with original pictures.

Hornsby and Schmidt's The Modern Hospital

The Modern Hospital. Its Inspiration; Its Construction; Its Equipment; Its Mangement. By JOHN A. HORNSBY, M. D., Secretary, Hospital Section, American Medical Association; and RICHARD E. SCHMIDT, Architect. Large octavo of 644 pages, with 207 illustrations. Cloth, $7.00 net; Half Morocco, $8.50 net. March, 1913

HOSPITAL EFFICIENCY

"Hornsby and Schmidt" tells you just exactly how to plan, construct, equip, and manage a hospital in all its departments, giving you every detail. It gives you exact data regarding heating, ventilating, plumbing, refrigerating, etc.—*and the costs.* It tells you how to equip a modern hospital with modern appliances. It tells you what you need in the operating room, the wards, the private rooms, the dining room, the kitchen—every division of hospital housekeeping. It gives you the duties of the directors, the superintendent, the various staffs, their relations to each other. It tells you all about nurses' training-schools—their management, curriculum, rules, regulations, etc. It gives you hundreds of valuable points on the business management of hospitals—large and small.

Howell Wright, *Superintendent City Hospital, Cleveland*

"To me the book is invaluable. I have a copy on my desk and scarcely a day passes but what I consult it and find what I want."

Allen's Local Anesthesia

Local Anesthesia. By CARROLL W. ALLEN, M. D., Instructor in Clinical Surgery at Tulane University of Louisiana. Octavo of 608 pages, illustrated. Cloth, $6.00 net; Half Morocco, $7.50 net.

COMPLETE IN EVERY PARTICULAR

This is a complete work on this subject. You get the history of local anesthesia, a chapter on nerves and sensation, giving particular attention to *pain*—what it is and its psychic control. Then comes a chapter on osmosis and diffusion. Each local anesthetic is taken up in detail, giving very special attention to *cocain* and *novocain*, pointing out the action on the nervous system, the value of adrenalin, paralysis caused by cocain anesthesia, control of toxicity. You get Crile's method of administering adrenalin and salt solution, the exact way to produce the intradermal wheal, to pinch the flesh for the insertion of the needle—all *shown* you step by step. You get full discussions of paraneural, intraneural, and spinal analgesia, intravenous and intra-arterial anesthesia, and Hackenbuck's regional anesthesia by circumferential injections. You get indications, contraindications, an article on *anoci-association*, with Crile's technic for producing anesthesia. Then the production of local anesthesia in the various regions is taken up in detail. Spinal analgesia and epidural injections are considered in a monogragh of 45 pages. Published October, 1914

The New Keen's Surgery

Surgery: Its Principles and Practice. Written by 81 eminent specialists. Edited by W. W. Keen, M. D., LL.D., Hon. F.R.C.S., Eng. and Edin., Emeritus Professor of the Principles of Surgery and of Clinical Surgery at the Jefferson Medical College. Six octavos of 1050 pages each, containing 3100 original illustrations, 157 in colors. Per volume: Cloth, $7.00 net; Half Morocco, $8.00 net.

VOLUME VI GIVES YOU THE NEWEST SURGERY

ALL THE ADVANTAGES OF A REVISION AT ONE-FIFTH THE COST

We have issued a Volume VI of "Keen"—the volume of the newest surgery. In this way you get all the advantages of a complete and thorough revision at but *one-fifth the cost.* It makes Keen's Surgery the best, the most up-to-date surgery on the market.

In this sixth volume you get the newest surgery—both general and special—from the pens of those same international authorities who have made the success of Keen's Surgery world-wide. Each man has searched for the new, the *really useful,* in his particular field, and he gives it to you here. Here you get the newest surgery, and fully illustrated. Then, further, you get a *complete index* to the entire six volumes, covering 125 pages, but so arranged that reference to it is extremely easy. If you want the newest surgery, you must turn to the new "Keen" for it.

Volume VI published March, 1913

Keen's War Wounds

Treatment of War Wounds. By W. W. Keen. 12mo of 125 pages, illustrated.

Ready in August, 1917

TREATMENTS BEING USED IN FRANCE

This work, compiled at the request of the National Research Council, reviews the latest information. It is obtained by *direct communication from the war hospitals in France.* It gives the formulas, preparation, application, and results of Carrel-Dakin's solution, eupad, eusol, and other antiseptics being used with such marked success. It takes up the removal of foreign bodies, treatment and prevention of tetanus, gas infection and gas gangrene, head wounds, abdominal wounds, ambrine and No. 7 paraffin for burns. It is an important book, instructive from cover to cover.

Crandon and Ehrenfried's Surgical After-treatment

Surgical After-treatment. A Manual of the Conduct of Surgical Convalescence. By L. R. G. CRANDON, M. D., Assistant in Surgery, and ALBERT EHRENFRIED, M. D., Assistant in Anatomy, Harvard Medical School. Octavo of 831 pages, with 265 original illustrations. Cloth, $6.00 net; Half Morocco, $7.50 net. **Published May, 1912**

SECOND EDITION—PRACTICALLY REWRITTEN

This work tells how best to manage all problems and emergencies of surgical convalescence from recovery-room to discharge. It gives *all the details* completely, definitely, yet concisely, and does not refer the reader to some other work perhaps not then available. The post-operative conduct of all operations is given, arranged alphabetically by regions. A special feature is the elaborate chapter on *Vaccine Therapy, Immunization by Inoculation and Specific Sera*, by Dr. George P. Sanborn, a disciple of Sir A. E. Wright. The text is illustrated.

The Therapeutic Gazette

"The book is one which can be read with much profit by the active surgeon and will be generally commended by him."

Papers from the Mayo Clinic

Collected Papers of the Mayo Clinic. By WILLIAM J. MAYO, M. D., CHARLES H. MAYO, M. D., and their ASSOCIATES at The Mayo Clinic, Rochester, Minn. Papers of 1905–1909, 1910, 1911, 1912, 1913. Each an octavo of about 800 pages, illustrated. Per volume: Cloth, $5.50 net. 1916 Papers (June, 1917): Cloth, $6.50 net; Half Morocco, $8.00 net.

THE NEWEST SURGICAL METHODS

These volumes give you all the clinical teachings, all the important papers of W. J. and C. H. Mayo and their associates at The Mayo Clinic. They give you the advances in operative technic, in methods of diagnosis as developed at this great clinic. This new volume, although called the *1916 volume*, gives you many papers that did not appear until *well into 1917*, quite a few being scheduled for as late as May and June. You should add this volume to your Mayo files.

Bulletin Medical and Chirurgical Faculty of Maryland

"Much of the work done at the Mayo Clinic and recorded in these papers has been epoch-making in character. * * * Represents a most substantial block of modern surgical progress."

A Collection of Papers (published previous to 1909). By WILLIAM J. MAYO, M. D., and CHARLES H. MAYO, M. D. Two octavos of 525 pages each, illustrated. Per set: Cloth, $10.00 net.

Moorhead's Traumatic Surgery

Traumatic Surgery. By JOHN J. MOORHEAD, M. D., Associate Professor of Surgery, New York Post-Graduate Medical School and Hospital. Octavo of 760 pages, with 520 original line-drawings. **Published February, 1917.** Cloth, $6.50 net; Half Morocco, $8.00 net.

REPRINTED TWICE IN THREE MONTHS

Here is a new book on just this side of your practice—a work for the general practitioner, the surgeon, the mining, railroad and industrial physician, those having to do with Compensation Law, accident insurance and claims, and legal medicine. To those medical men engaged in or preparing for *military service* this work is proving of great value. For instance, it gives you at first hand the *open air and sunlight treatment* of wounds and *Dakin's solution*, its formula and application—treatments the European War has brought forward so emphatically.

DaCosta's Modern Surgery

Modern Surgery—GENERAL AND OPERATIVE. By JOHN CHALMERS DACOSTA, M. D., Samuel D. Gross Professor of Surgery, Jefferson Medical College, Philadelphia. Octavo of 1515 pages, with 1085 illustrations. **April, 1914** Cloth, $6.00 net; Half Morocco, $7.50 net.

SEVENTH EDITION

A surgery, to be of the maximum value, must be up to date, must be complete, must have behind its statements the sure authority of experience, must be so arranged that it can be consulted quickly; in a word, it must be practical and dependable. Such a surgery is DaCosta's. Always an excellent work, for this edition it has been very materially improved by the addition of new matter to the extent of over 250 pages and by a most thorough revision of the old matter. Many old cuts have been replaced by new ones, and nearly 150 additional illustrations have been added.

Rudolph Matas, M. D., *Professor of Surgery, Tulane University of Louisiana.*

"This edition is destined to rank as high as its predecessors, which have placed the learned author in the fore of text-book writers. The more I scrutinize its pages the more I admire the marvelous capacity of the author to compress so much knowledge in so small a space."

Scudder's Treatment of Fractures

WITH NOTES ON DISLOCATIONS

The Treatment of Fractures: with Notes on a few Common Dislocations. By CHARLES L. SCUDDER, M. D., Assistant Professor of Surgery at Harvard Medical School. Octavo of 734 pages, with 1057 original illustrations. Polished Buckram, $6.00 net; Half Morocco, $7.50 net.

Published June, 1915

THE NEW (8th) EDITION, ENLARGED WITH 1057 ILLUSTRATIONS

The fact that this work has attained an eighth edition indicates its practical value. In this edition Dr. Scudder has made numerous additions throughout the text, and has added many new illustrations, greatly enhancing the value of the work. In every way this new edition reflects the very latest advances in the treatment of fractures.

J. F. Binnie, M.D., University of Kansas

"Scudder's Fractures is the most successful book on the subject that has ever been published. I keep it at hand regularly."

Scudder's Tumors of the Jaws

Tumors of the Jaws. By CHARLES L. SCUDDER, M. D., Assistant Professor of Surgery at Harvard Medical School. Octavo of 395 pages, with 353 illustrations, 6 in colors. Cloth, $6.50 net; Half Morocco, $8.00 net.

Published February, 1912

WITH NEW ILLUSTRATIONS

Dr. Scudder in this book tells you how to determine in each case the *form* of new growth present and then points out the best treatment. As the tendency of malignant disease of the jaws is to grow into the accessory sinuses and toward the base of the skull, an intimate knowledge of the anatomy of these sinuses is essential. Dr. Scudder has included, therefore, sufficient anatomy and a number of illustrations of an anatomic nature. Whether general practitioner or surgeon, you need this new book because it gives you just the information you want.

Cotton's
Dislocations and Joint Fractures

Dislocations and Joint Fractures. By FREDERIC JAY COTTON, M. D., First Assistant Surgeon to the Boston City Hospital. Octavo of 654 pages, with 1201 original illustrations. Cloth, $6.00 net; Half Morocco, **$7.50 net.** **Published July, 1910**

TWO PRINTINGS IN EIGHT MONTHS

Dr. Cotton's clinical and teaching experience in this field has especially fitted him to write a practical work on this subject. He has written a book clear and definite in style, systematic in presentation, and accurate in statement. The illustrations possess the feature of showing just those points the author wishes to emphasize. This is made possible because the author is himself the artist.

Boston Medical and Surgical Journal

"The work is delightful, spirited, scholarly, and original, and is not only a book of reference, but a book for casual reading. It brings the subject up to date, a feat long neglected."

The Surgical Clinics of Chicago

The Surgical Clinics of Chicago. By leading Chicago surgeons. Issued serially, one octavo of 200 pages, illustrated, every other month (six volumes a year). Per Clinic Year (February to December): Cloth, $14.00 net; Paper, $10.00 net.

SURGERY FROM THE CLINICAL SIDE

This new bi-monthly considers *all departments of surgery* from the *clinical side*, giving particular emphasis to differential diagnosis and treatment. It gives you the actual word for word clinics of *40 great teacher-surgeons* of Chicago, representing all the important hospitals of that great center of post-graduate instruction. You get the day-in and day-out teachings of these men. You get their tried and proved methods of diagnosis; their operative technic; their plans of management; the benefit of their years of experience, with a wealth of clinical material unequalled for variety and quantity. Add to the matter of the books the illustrations by Tom Jones, and the result is *practically applied, absolutely fresh* teachings, embodying all the new methods.

Kelly & Noble's Gynecology and Abdominal Surgery

Gynecology and Abdominal Surgery. Edited by HOWARD A. KELLY, M.D., Professor of Gynecology in Johns Hopkins University; and CHARLES P. NOBLE, M.D., formerly Clinical Professor of Gynecology in the Woman's Medical College, Philadelphia. Two imperial octavo volumes of 950 pages each, containing 880 original illustrations, some in colors. Per volume: Cloth, $8.00 net; Half Morocco, $9.50 net.

Volume I published May, 1907; Volume II published June, 1908

WITH 880 ILLUSTRATIONS—TRANSLATED INTO SPANISH

This work possesses a number of valuable features not to be found in any other publication covering the same fields. It contains a chapter upon the bacteriology and one upon the pathology of gynecology, and a large chapter devoted entirely to *medical gynecology*, written especially for the physician engaged in general practice. *Abdominal surgery* proper, as distinct from gynecology, is fully treated, embracing operations upon the stomach, intestines, liver, bile-ducts, pancreas, spleen, kidneys, ureter, bladder, and peritoneum.

American Journal of Medical Sciences

"It is needless to say that the work has been thoroughly done; the names of the authors and editors would guarantee this, but much may be said in praise of the method of presentation, and attention may be called to the inclusion of matter not to be found elsewhere."

Cushing's Brain Tumors

Tumors of the Nervus Acusticus and the Syndrome of the Cerebellopontine Angle. By HARVEY CUSHING, M. D., Surgeon-in-Chief, Peter Bent Brigham Hospital, Boston. Octavo of 350 pages, fully illustrated.

READY SOON—A FULLY ILLUSTRATED STUDY

Dr. Cushing presents here an exhaustive study of tumors of the acoustic nerve. He gives you his own technic, and the results of study and observation of some thirty cases—a thorough presentation of the subject, embracing history, analysis of symptoms, physical examination, morphology, histology, and operative technic. You are given not only the surgical aspects, but the historical, symptomatic, and pathologic as well. The illustrations are particularly noteworthy.

Moynihan's Abdominal Operations

Abdominal Operations. By SIR BERKELEY MOYNIHAN, M. S. (LONDON), F. R. C. S., of Leeds, England. Two octavos, totaling nearly 1000 pages, with 385 illustrations. Per set: Cloth, $11.00 net; Half Morocco, $14.00 net. **Published October, 1914**

THIRD EDITION, ENLARGED

This *new (3d) edition* was so thoroughly revised that the work had to be reset from cover to cover. Over 150 pages of new matter and some 85 new illustrations were added, making 385 illustrations, 5 of them in colors—really an *atlas of abdominal surgery*. This work is a personal record of Moynihan's operative work. You get his own successful methods of diagnosis. You get his own technic, in every case fully illustrated with handsome pictures. You get the bacteriology of the stomach and intestines, sterilization and preparation of patient and operator. You get complications, sequels, and after-care. Then the various operations are detailed with forceful clearness, discussing first gastric operations, following with intestinal operations, operations upon the liver, the pancreas, the spleen. Two new chapters added in this edition are *excision of gastric ulcer* and *complete gastrectomy*, giving the latest developments in these operative measures.

Moynihan's Duodenal Ulcer

Second Edition

Duodenal Ulcer. By SIR BERKELEY MOYNIHAN, M. S. (LONDON), F. R. C. S., Leeds, England. Octavo of 486 pages, illustrated. Cloth, $5.00 net; Half Morocco, $6.50 net. **Published March, 1912**

For the *practitioner*, who first meets with these cases, Mr. Moynihan fixes the diagnosis with precision, so that the case, if desired, may be referred in the early stage to the surgeon. The *surgeon* finds here the newest and best technic as used by one of the leaders in this field.

"Easily the best work on the subject; coming, as it does, from the pen of one of the masters of surgery of the upper abdomen, it may be accepted as authoritative."—*London Lancet.*

Moynihan on Gall-stones

Second Edition

Gall-stones and Their Surgical Treatment. By SIR BERKELEY MOYNIHAN, M. S. (LONDON), F. R. C. S., Leeds, England. Octavo of 458 pages, illustrated. Cloth, $5.00 net; Half Morocco, $6.50 net. **October, 1904**

This work gives special attention to the early symptoms in cholelithiasis, enabling you to diagnose the case in the early stages.

"We can heartily recommend this work as most satisfactory and of the greatest practical value."—*American Journal of the Medical Sciences.*

Fenger Memorial Volumes

Fenger Memorial Volumes. Edited by LUDVIG HEKTOEN, M. D., Rush Medical College, Chicago. Two octavos of 525 pages each. Per set: Cloth, $15.00 net; Half Morocco, $18.00 net. **Published May, 1912**

LIMITED EDITION

These handsome volumes consist of all the important papers written by the late Christian Fenger, for many years professor of surgery at Rush Medical College, Chicago. Not only the papers published in English are included, but also those which originally appeared in Danish, German, and French.

The name of Christian Fenger typifies thoroughness, extreme care, deep research, and sound judgment. His contributions to the advancement of the world's surgical knowledge are indeed as valuable and interesting reading to-day as at the time of their original publication. They are pregnant with suggestions. Fenger's literary prolificacy may be judged from this memorial volume—over 1000 pages.

Owen's Treatment of Emergencies

The Treatment of Emergencies. By HUBLEY R. OWEN, M. D., Surgeon to the Philadelphia General Hospital. Octavo of 350 pages, with 249 illustrations. **Published June, 1917** Cloth, $2.00 net.

METHODS AND PRINCIPLES

Dr. Owen's book gives you not only the *actual technic* of the procedures, but also the underlying principles of the treatments, and the reason *why* a particular method is advised. You get chapters on fractures of all kinds, contusions, and wounds. Particularly strong is the chapter on *gunshot wounds*, which gives the new treatments that the great European War has developed. You get the principles of hemorrhage, together with its constitutional and local treatments. You get chapters on sprains, dislocations, burns, sunburn, chilblain, asphyxiation, convulsions, hysteria, apoplexy, exhaustion, opium poisoning, uremia, electric shock, bandages, and a complete discussion of the various methods of artificial respiration, including mechanical devices.

Radasch's Anatomy

Manual of Anatomy. By HENRY E. RADASCH, M. D., Assistant Professor of Histology and Biology, Jefferson Medical College. Octavo of 489 pages, with 329 illustrations. Cloth, $3.50 net. **Published August, 1917**

Dr. Radasch's new handbook is complete in both text and illustrations. Every effort has been taken to make the study of anatomy both easy and interesting, the many illustrations contributing markedly to this end.

Bryan's Surgery

Principles of Surgery. By W. A. BRYAN, M. D., Professor of Surgery and Clinical Surgery at Vanderbilt University, Nashville. Octavo of 677 pages, with 224 original illustrations. Cloth, $4.00 net.

Dr. Bryan here gives you facts, accurately and concisely stated, without which no modern practitioner can do modern work. He shows you in a most practical way the relations between surgical pathology and the resultant symptomatology, and points out the influence such information has on *treatment.* **Published November, 1913**

Mumford's Practice of Surgery

The Practice of Surgery. By JAMES G. MUMFORD, M. D., Instructor in Surgery, Harvard Medical School. Octavo of 1032 pages, with 681 illustrations. **Second Edition published June, 1914.** Cloth, $7.00 net; Half Morocco, $8.50 net.

Fowler's Operating Room **Third Edition, Reset**

The Operating Room and the Patient. By RUSSELL S. FOWLER, M. D., Surgeon to the German Hospital, Brooklyn, New York. Octavo of 611 pages, illustrated. **Published March, 1913.** Cloth, $3.50 net.

Whiting's Bandaging

Bandaging. By A. D. WHITING, M. D., Instructor in Surgery at the University of Pennsylvania. 12mo of 151 pages, with 117 illustrations. Cloth, $1.25 net. **Published November, 1915**

Nancrede's Essentials of Anatomy **Eighth Edition**

Essentials of Anatomy, including the Anatomy of the Viscera. By CHAS. B. NANCREDE, M.D., Professor of Surgery and of Clinical Surgery, University of Michigan, Ann Arbor. Crown octavo, 430 pages; 154 cuts. With an Appendix containing over 60 illustrations. Based on *Gray's Anatomy.* **Published October, 1911.** Cloth, $1.25 net. *In Saunders' Question Compends.*

Martin's Essentials of Surgery **Seventh Edition**

Essentials of Surgery. Containing also Venereal Diseases, Surgical Landmarks and Minor and Operative Surgery, and a complete description, with illustrations, of the Handkerchief and Roller Bandages. By EDWARD MARTIN, A. M., M. D., Professor of Clinical Surgery, University of Pennsylvania, etc. Crown octavo, 338 pages, illustrated.

Published 1897. Cloth, $1.25 net. *In Saunders Question Compends.*

Metheny's Dissection Methods

Dissection Methods and Guides. By DAVID GREGG METHENY, M. D., L. R. C. P., L. R. C. S. (EDIN.), L. F. P. S. (GLAS.), Associate in Anatomy, Jefferson Medical College, Philadelphia. Octavo of 131 pages, illustrated.

Published November, 1914. Cloth, $1.25 net.

Crile and Lower's Anoci-Association

Anoci-Association. By GEORGE W. CRILE, M. D., Professor of Surgery, and WILLIAM E. LOWER, M. D., Associate Professor of Genito-Urinary Surgery, Western Reserve University. 275 pages, illustrated. Cloth, $3.00 net.

Anoci-association is *the new way of anesthetizing.* It *prevents shock*, it robs surgery of its harshness, it diminishes postoperative mortality, it lessens the likelikood of nausea, vomiting, gas-pains, backache, nephritis, pneumonia, and other postoperative complications. You get anoci-association and blood-pressure and the technic of nitrous-oxid-oxygen anesthesia. **Published July, 1914**

Crile's The Kinetic Drive

The Kinetic Drive: Its Phenomena and Control. By GEORGE W. CRILE, M. D., Professor of Surgery, Western Reserve University, Cleveland. Octavo of 71 pages, illustrated. **Published May, 1916** Cloth, $2.00 net.

In this book Dr. Crile analyzes the mechanism by which the present-day industrial and commercial "speeding" is accomplished, and relates it to the speeding due to other stimuli, such as infections, auto-intoxication, physical injury, etc.

Keen's Addresses and Other Papers

Addresses and Other Papers. Delivered by WILLIAM W. KEEN, M. D., LL.D., F. R. C. S. (Hon.), Professor of the Principles of Surgery and of Clinical Surgery, Jefferson Medical College, Philadelphia. Octavo volume of 441 pages, illustrated. **Published May, 1905.** Cloth, $3.75 net.

Keen on the Surgery of Typhoid

The Surgical Complications and Sequels of Typhoid Fever. By WM. W. KEEN, M.D., LL.D., F.R.C.S. (Hon.), Professor of the Principles of Surgery and of Clinical Surgery, Jefferson Medical College, Philadelphia, etc. Octavo volume of 386 pages, illustrated. **Published 1898** Cloth, $3.00 net.

Dannreuther's Minor and Emergency Surgery

Minor and Emergency Surgery. By WALTER T. DANNREUTHER, M. D., Surgeon to St. Elizabeth's Hospital and to St. Bartholomew's Clinic, New York City. 12mo of 225 pages, illustrated. Cloth, $1.25 net. **Published Oct., 1911**

Bier's Hyperemia

Second Edition, June, 1909

Bier's Hyperemic Treatment in Surgery, Medicine, and the Specialties: A Manual of its Practical Application. By WILLY MEYER, M. D., Professor of Surgery at the New York Post-Graduate Medical School and Hospital; and PROF. DR. VICTOR SCHMIEDEN, Assistant to Prof. Bier, University of Berlin, Germany. Octavo of 280 pages, with original illustrations. Cloth, $3.00 net.

"We commend this work to all those who are interested in the treatment of infections, either acute or chonic, for it is the only authoritative treatise we have in the English language."—*New York State Journal of Medicine.*

Morris' Dawn of the Fourth Era in Surgery

Dawn of the Fourth Era in Surgery and Other Articles. By ROBERT T. MORRIS, M. D., New York Post-Graduate Medical School and Hospital. 12mo of 145 pages, illustrated. **August, 1910.** $1.25 net.

American Illustrated Dictionary

The New (8th) Edition

The American Illustrated Medical Dictionary. With tables of Arteries, Muscles, Nerves, Veins, etc.; of Bacilli, Bacteria, etc.; Eponymic Tables of Diseases, Operations, Stains, Tests, etc. By W. A. NEWMAN DORLAND, M.D. Large octavo, 1137 pages. Flexible leather, $4.50 net; with thumb index, $5.00 net. **Published August, 1915**

Howard A. Kelly, M.D., *Professor of Gynecology, Johns Hopkins University, Baltimore.*

"Dr. Dorland's dictionary is admirable. It is so well gotten up and of such convenient size. No errors have been found in my use of it."

Golebiewski and Bailey's Accident Diseases

Atlas and Epitome of Diseases Caused by Accidents. By DR. ED. GOLEBIEWSKI, of Berlin. Edited, with additions, by PEARCE BAILEY, M.D. Consulting Neurologist to St. Luke's Hospital, New York City. With 71 colored figures on 40 plates, 143 text-cuts, and 549 pages of text. Cloth, $4.00 net. *In Saunders' Hand-Atlas Series.* **Published 1900**

Helferich and Bloodgood on Fractures

Atlas and Epitome of Traumatic Fractures and Dislocations By PROF. DR. H. HELFERICH, of Greifswald, Prussia. Edited, with additions, by JOSEPH C. BLOODGOOD, M. D., Associate in Surgery, Johns Hopkins University, Baltimore. 216 colored figures on 64 lithographic plates, 190 text-cuts, and 353 pages of text. Cloth, $3.00 net. *In Saunders' Atlas Series.* **Published June, 1902**

Sultan and Coley on Abdominal Hernias

Atlas and Epitome of Abdominal Hernias. By PR. DR. G. SULTAN, of Gottingen. Edited, with additions, by WM. B. COLEY, M. D., Clinical Lecturer and Instructor in Surgery, Columbia University, New York. 119 illustrations, 36 in colors, and 277 pages of text. Cloth. $3.00 net. *In Saunders' Hand-Atlas Series.* **Published June, 1902**

American Pocket Dictionary

New (9th) Edition

The American Pocket Medical Dictionary. Edited by W. A. NEWMAN DORLAND, A. M., M. D., Editor "American Illustrated Medical Dictionary." 693 pages. Full leather, limp, with gold edges, $1.25 net; with patent thumb index, $1.50 net. **Published April, 1915**

Zuckerkandl and DaCosta's Surgery

Second Edition

Atlas and Epitome of Operative Surgery. By DR. O. ZUCKERKANDL, of Vienna. Edited, with additions, by J. CHALMERS DACOSTA, M.D., Samuel D. Gross Professor of Surgery, Jefferson Medical College, Philadelphia. 40 colored plates, 278 text-cuts, and 410 pages of text. Cloth, $3.50 net. *In Saunders' Atlas Series.* **Published 1902**

COUNTWAY LIBRARY
HC 16WG 8

17.A.81.
Diseases of the genito-urinary 1917
Countway Library AGT1821
3 2044 045 066 404

17.A.81.
Diseases of the genito-urinary 1917
Countway Library AGT1821
3 2044 045 066 404